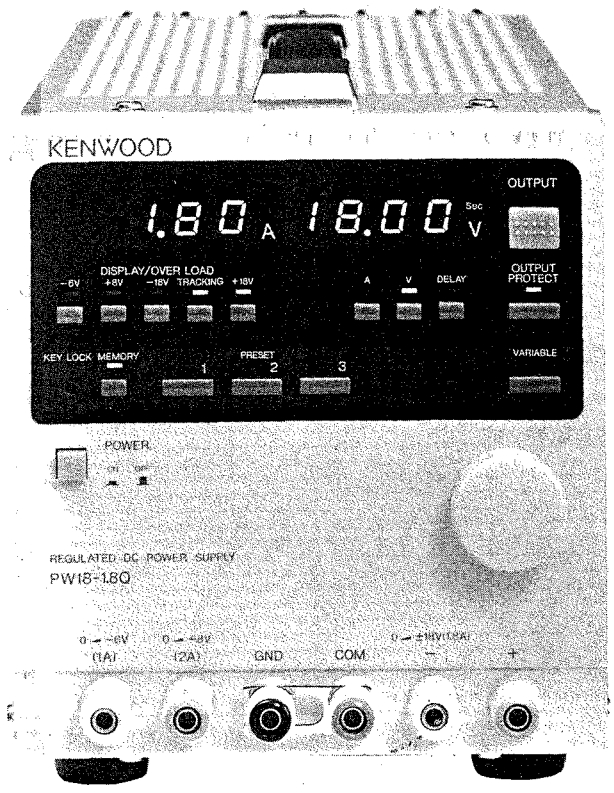
KENWOOD

REGULATED DC POWER SUPPLY

PW18-1.8Q

SERVICE MANUAL

KENWOOD CORPORATION



WARNING

The following instructions are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than contained in the operating instructions unless you are qualified to do so.

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SPECIFICATIONS

Model	PW18-1.8Q		
OUTPUT VOLTAGE			
Output voltage	0 to +18V/0 to −18V	0 to +8V	0 to −6V
Setting resolution	10mV		
Max. output voltage	+18V/−18V	+8.0V	−6.0V
Dual tracking	0 to ±18V		
Tracking deviation	±(1%+40mV) of rated voltage		
OUTPUT CURRENT			
Output current	0 to +1.8A/0 to −1.8A	0 to +2A	0 to −1A
Setting resolution	10mA		
Max. output current	+1.8A/−1.8A	+2.0A	−1.0A
Dual tracking	0 to ±1.8A		
Tracking deviation	(2%+40mA) of rated current		
CONSTANT VOLTAGE CHARACTERISTICS			
Input fluctuation (for surge of AC±10%)	1mV		
Load fluctuation (for surge of 0 to 100%)	3mV		
Ripple/noise rms (10Hz to 1MHz)	0.5mV rms		
Ripple peak (p-p)	2.8mV p-p		
Transient response	50μs Typical		
Temperature coefficient	100ppm/°C Typical		
CONSTANT CURRENT CHARACTERISTICS			
Input fluctuation (for surge of AC±10%)	2mA Typical		
Load fluctuation (for surge of 0 to 100%)	10mA Typical		
Ripple/noise rms (10Hz to 1MHz)	2mA rms Typical		
Ripple peak (p-p)	5.6mA p-p Typical		
Temperature coefficient	300ppm/°C Typical		
VOLTMETER			
Display (3-1/2 digit LED)	max. 19.99V, fixed range red LED		
Accuracy (output "ON")	±(0.5% rdg+2 digit) (23°C±5°C, less than 80% RH)		
AMPMETER			
Display (3 digit LED)	max. 9.99A, fixed range red LED		
±Accuracy (output "ON")	(1.0% rdg+2 digit) 23°C±5°C, less than 80% RH		
FUNCTIONS			
Output ON/OFF	ON/OFF switch. However, output cannot be ON when MEMORY ON. Red LED lights up when ON.		
Output protect ON/OFF	Disables the output of unexpected voltage and current in the output mode. This 'PROTECT' function becomes active when a different value is set by one of the PRESET, VARIABLE and TRACKING keys in the output mode. (ON→Red LED active)		
Preset (1,2,3)	3 voltages or currents can be preset as desired. Preset values can be easily checked. Green LED lights up when ON.		

SPECIFICATIONS

Model	PW18-1.8Q
Memory	Several voltage and current presets can be stored. Red LED lights when ON.
Key Lock	Locks all functions as set. All controls except POWER are disabled. Red LED.
Delay	ON/OFF DELAY of ±18V and +8V/−6V output. Green LED lights up when ON.
V/A	Several voltages and currents can be set. Green LED.
Tracking and V/A display selection	±18V tracking, +18V, −18V, +8V, −6V
OUTPUT	
COM	±18V +8V, −6V COM common
Polarity	COM, positive or negative ground possible
Output terminals	+ (red), − (white), COM (blue), GND (black)
Ground proof voltage	±250V DC
SERIAL OUTPUT	0 to 36V
OPERATION CONDITIONS	
Rated temperature/humidity range	0 to 40°C, 10 to 85% RH
Operation temperature/humidity range	0 to 40°C, 10 to 85% RH
Storage temperature/humidity range	−20 to 65°C, 10 to 85% RH
Cooling mechanism	Natural convection
POWER CONSUMPTION	
VA/W (at AC 100V)	approx. 240VA/213W
INPUT VOLTAGE	
Voltage, Frequency	AC 100V/120V/220V/240V±10% (max. 250V) 50/60Hz Internal switching possible.
DIMENSIONS AND WEIGHT	
Dimensions	width: 138mm height: 147mm depth: 372mm
Max. dimensions	width: 143mm height: 167mm depth: 392mm
Weight	approx. 8.2kg
Accessory items	1 instruction manual 1 power supply cord 2 fuses

■ Circuit and ratings are subject to change without notice due to developments in technology.

SAFETY

SAFETY

Before connecting the instrument to a power source, carefully read the following information, then verify that the proper power cord is used and the proper line fuse is installed for power source. If the power cord is not applied for specified voltage, there is always a certain amount of danger from electric shock.

Line voltage

This instrument operates using ac-power input voltages that 100/120/220/240 V at frequencies from 50 Hz to 60 Hz.

Power cord

The ground wire of the 3-wire ac power plug places the chassis and housing of the instrument at earth ground. Do not attempt to defeat the ground wire connection or float the instrument; to do so may pose a great safety hazard. The appropriate power cord is supplied by an option that is specified when the instrument is ordered.
The optional power cords are shown as follows in Fig. 1.

Line fuse

The fuse holder is located inside the instrument and contains the line fuse. Verify that the proper fuse is installed by replacing the line fuse.

Voltage conversion

This instrument may be operated from either a 100 V to 240 V, 50/60 Hz power source. Use the following procedure to change from 100 to 240 volt operation or vice versa.

1. Remove the case. Change the power voltage according to instruction manual.
2. Replace the fuse with a fuse of appropriate value, 3 amp for 100 VAC to 120 VAC operation, 1.5 amp for 220 VAC to 240 VAC operation.
3. When performing the reinsertion of fuse for the voltage conversion, the appropriate power cord should be used. (See Fig. 1.)

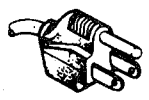
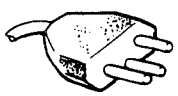
Plug configuration	Power cord and plug type	Factory installed instrument fuse	Line cord plug fuse	Parts No. for power cord set
	North American 120 volt/60 Hz Rated 15 amp (12 amp max; NEC)	3 A, 250 V Slow blow 6×30 mm	None	Cord: E30-1820-05
	Universal Europe 220 volt/50 Hz Rated 16 amp	1.5 A, 250 V Slow blow 6×30 mm	None	Cord: E30-1819-05
	U.K. 240 volt/50 Hz Rated 13 amp	1.5 A, 250 V Slow blow 6×30 mm	0.8 A Type C	—
	Australian 240 volt/50 Hz Rated 10 amp	1.5 A, 250 V Slow blow 6×30 mm	None	Cord: E30-1821-05
	North American 240 volt/60 Hz Rated 15 amp (12 amp max; NEC)	1.5 A, 250 V Slow blow 6×30 mm	None	—
	Switzerland 240 volt/50 Hz Rated 10 amp	1.5 A, 250 V Slow blow 6×30 mm	None	—

Fig. 1 Power Input Voltage Configuration

CIRCUIT DESCRIPTION

+/−12 V AND +5 V GENERATOR

AC voltages from the AC Power Transformer T1 are first transformed into +/− DC power by a center-tap type control rectifier and smoother, (D1) and (C1 and C2). The center tap of the transformer is used as a reference. The +/− 12 V is then generated through U1 and U2 circuits after which the +5 V is generated from +12 V through the U3 circuit. The generated +/− 12 V and +5 V are used as control power of the main power source and their reference includes all the references of the center tap. The potentials are directly connected to the COM.

AC POWER SWITCH (K1) AND AC POWER DRIVE (Q5)

The main AC power source, for the power source +18 V output, is input from the AC Power Transformer T1. Two types of potentials, based on references of one tap, become input. As a transfer relay is used in K1, only one potential can be provided for the Rectifier and Smoother. K1 is controlled by Q5 and when Q5 is ON, K1 provides a high voltage to the Rectifier and Smoother. When Q5 is OFF, K1 provides a low voltage to the same.

AC POWER SWITCH (K2) AND AC POWER DRIVE (Q6)

The main AC power source, for the power source −18 V output, is input from the AC Power Transformer T1. The concept here is the same as the +18 V output, except that K1 is replaced by K2 and Q5 is replaced by Q6.

RECTIFIER AND SMOOTHER (D51 AND C51)

AC Power output from K1 becomes transformed into DC power.

RECTIFIER AND SMOOTHER (D52 AND C52)

AC Power output from K2 becomes transformed into DC power.

RECTIFIER AND SMOOTHER (D57 AND C51)

Main AC power for the power source +8 V output becomes input from T1 and transformed into DC power.

RECTIFIER AND SMOOTHER (D58 AND C54)

Main AC power for the power source −6 V output becomes input from T1 and transformed into DC power.

SERIES PASS TRANSISTORS (Q11 AND Q12)

Unstable DC power, output from D51 and C51, are transformed into stable AC power. Transistors (Q11 and Q12) for NPN coupling are connected in series and regulated by signals from amplifiers (Q1 o7 3 and R52).

SERIES PASS TRANSISTORS (Q13 AND Q14)

Unstable DC power, output from D52 and C52, are transformed into stable AC power. Transistors (Q13 and Q14) for NPN coupling are connected in series and regulated by signals from amplifiers (Q2 and R53).

SERIES PASS TRANSISTORS (Q15 AND Q16)

Unstable DC power, output from D57 and C53, are transformed into stable AC power. Transistors (Q15 and Q16) for NPN coupling are connected in series and regulated by signals from amplifiers (Q3 and R54).

SERIES PASS TRANSISTOR (Q17)

Unstable DC power, output from D58 and C54, are transformed into stable AC power. This section is made up of Transistor (Q17) for NPN coupling and regulated by signals from amplifiers (Q4 and R55).

CURRENT DETECTOR (R59) AND VOLTAGE DIVIDER (VR3 AND R63)

Stable DC power output from Q11 is led to the Power ON/OFF [K102 (1/2)] via R59. The electric current input into R59 becomes output as voltage. This voltage input through VR3 and R63 becomes potential divided and in turn input into the Error Current Amplifier (U5b).

CURRENT DETECTOR (R60) AND VOLTAGE DIVIDER (VR4 AND R64)

Stable DC power output from Q13 and Q14 is led to the Power ON/OFF [K102(2/2)] via R60. The electric current input into R60 becomes output as voltage. This voltage input through VR4 and R64 becomes potential divided and in turn input into the Error Current Amplifier (U6b).

CURRENT DETECTOR (R61) AND VOLTAGE DIVIDER (VR5 AND R65)

Stable DC power output from Q15 and 16 is led to the Power ON/OFF [K104 (1/2)] via R61. The electric current input into R61 becomes output as voltage. This voltage input through VR5 and R65 becomes potential divided and in turn input into the Error Current Amplifier (U7b).

CIRCUIT DESCRIPTION

CURRENT DETECTOR (R62) AND VOLTAGE DIVIDER (VR6 AND R66)

Stable DC power output from Q17 is led to the Power ON/OFF [K104 (2/2)] via R62. The electric current input into R62 becomes output as voltage. This voltage input through VR6 and R66 becomes potential divided and in turn input into the Error Current Amplifier (U8a).

POWER ON/OFF [K102 (1/2) AND K102 (2/2)] SWITCHES AND POWER ON/OFF DRIVE (Q101)

Each +18 V and −18 V DC power, output from R59 and R60, passes through the Power ON/OFF switch (K102) and in turn output from the Power Source +18 V and −18 V Output Terminals. K102 (1/2) outputs positive power while K102 (2/2) outputs negative power, both of which use two units of relays each. The ON/OFF of +18 V and −18 V is done simultaneously.

K102 is controlled by the Power Output ON/OFF Drive (Q101).

K102 is ON when Q101 is ON and the power is output. K102 is OFF when Q101 is OFF and no power is output.

POWER OUTPUT ON/OFF SWITCHES [K104 (1/2 AND 2/2)] AND POWER OUTPUT ON/OFF DRIVE (Q102)

Each +8 V and −6 V DC power, output from R61 and R62, passes through the Power ON/OFF switch (K104) and in turn output from the power Source +8 V and −6 V

Output Terminals. K104 (1/2) outputs positive power while K102 (2/2) outputs negative power, both of which use two units of relays each. The ON/OFF of +8 V and −6 V is done simultaneously.

K104 is controlled by the Power Output ON/OFF Drive (Q102).

K104 is ON when Q102 is ON and the power is output. K104 is OFF when Q102 is OFF and no power is output.

POWER OUTPUT DETECTION SWITCHES [K101 (1/2 AND 2/2)], POWER OUTPUT DETECTION DRIVE (Q103), AND DIGITAL DELAY (U102, D110, R124, AND C124).

For power output adjustment, +18 V is input into K101 (1/2) while −18 V is input into K101 (2/2). Output is then made to each corresponding voltage divider.

Both K101 (1/2) and K101 (2/2) constitute two transfer relays each. K101 is controlled by Q103. When Q103 is ON, K101 becomes connected to the output side of K102 and the signal becomes input into the voltage divider. When Q103 is OFF, K101 becomes connected to the power detection side of K102 and the signal becomes input into the voltage divider.

Q103 is controlled by signals from the Digital Delay (U102, D110, R124, and C124). Signals which turn Q101 ON/OFF are buffered and sent as signals for turning Q103 ON/OFF. In case of ON, signals sent to Q103 are delayed, versus those sent to Q101.

POWER OUTPUT DETECTION SWITCHES [K103 (1/2 AND 2/2)], POWER OUTPUT DETECTION DRIVE (Q104), AND DIGITAL DELAY (U102, D111, R126, AND C123).

For power output adjustment, +8 V is input into K103 (1/2) while −6 V is input into K103 (2/2). Output is then made to each corresponding voltage divider.

Both K103 (1/2) and K103 (2/2) constitute two transfer relays each. K103 is controlled by Q104. When Q104 is ON, K103 becomes connected to the output side of K104 and the signal becomes input into the voltage divider. When Q104 is OFF, K103 becomes connected to the power detection side of K104 and the signal becomes input into the voltage divider. Q104 is controlled by signals from the Digital Delay (U102, D111, R126, and C123). Signals which turn Q102 ON/OFF are buffered and sent as signals for turning Q104 ON/OFF. In case of ON, signals sent to Q104 are delayed, versus those sent to Q102.

VOLTAGE DIVIDERS (R18 AND R22) & (R17 AND R21)

The electrical potentials output from K101 (1/2) and K101 (2/2) are divided by voltage dividers R18 and R22, and R17 an R21. The divided potentials are then input into Error Current Amplifiers.

VOLTAGE DIVIDERS (R16 AND R20) & (R15 AND R19)

The electrical potentials output from K103 (1/2) and K103 (2/2) are divided by voltage dividers R16 and R20, and R15 and R19. The divided potentials are then input into Error Current Amplifiers.

VOLTAGE DIVIDER (R40)

R40 constitutes a complex resistor of 2k and 10k. The electric potential output from K102 (1/2) is sent to the 10k resistance side while that output from the Reference Voltage Generator [U5 a, U21, R23, C22, and C40) is sent to the 2k resistance side. The COM potentials of the 2k and 10k resistor become input into the Error Current Amplifier (U9a).

VOLTAGE DIVIDER (R41)

R41 constitutes a complex resistor of 2k and 10k. The electric potential output from K102 (2/2) is sent to the 10k resistance side while that output from the Reference Voltage Generator [U6 (a), U22, R25, C24, and C41) is sent to the 2k resistance side. The COM potentials of the 2k and 10k resistor become input into the Error Current Amplifier (U9b).

CIRCUIT DESCRIPTION

VOLTAGE DIVIDER (R42)

R42 constitutes a complex resistor of 2k and 10k. The electric potential output from K103(1/2) is sent to the 10k resistance side while that output from the Reference Voltage Generator [U7 a, R29, and C28] is sent to the 2k resistance side. The COM potentials of the 2k and 10k resistor become input into the Error Current Amplifier (U10a).

VOLTAGE DIVIDER (R43)

R43 constitutes a complex resistor of 2k and 10k. The electric potential output from K103 (2/2) is sent to the 10k resistance side while that output from the Reference Voltage Generator [U8 a, R29, C22, and C28) is sent to the 2k resistance side. The COM potentials of the 2k and 10k resistor become input into the Error Current Amplifier (U10a).

ERROR CURRENT AMPLIFIER (U5b)

The electric potentials output from the Voltage Dividers (VR3 and R63) and those output from the Reference Voltage Generator A (R24 and C23) are compared and their errors amplified. They are then input into Signal Selectors (D19 and D20).

ERROR CURRENT AMPLIFIER (U6b)

The electric potentials output from the Voltage Dividers (VR4 and R64) and those output from the Reference Voltage Generator A (R26 and C25) are compared and their errors amplified. They are then input into Signal Selectors (D21 and D22).

ERROR CURRENT AMPLIFIER (U7b)

The electric potentials output from the Voltage Dividers (VR5 and R65) and those output from the Reference Voltage Generator A (R28 and C27) are compared and their errors amplified. They are then input into Signal Selectors (D23 and D24).

ERROR CURRENT AMPLIFIER (U8b)

The electric potentials output from the Voltage Dividers (VR6 and R66) and those output from the Reference Voltage Generator A (R30 and C29) are compared and their errors amplified. They are then input into Signal Selectors (D25 and D26).

ERROR VOLTAGE AMPLIFIER (U9a)

The electric potentials output from the Voltage Divider (R40) and COM electrical potentials are compared and their errors amplified. They are then input into Signal Selectors (D19 and D20).

ERROR VOLTAGE AMPLIFIER (U9b)

The electric potentials output from the Voltage Divider (R41) and COM electrical potentials are compared and their errors amplified. They are then input into Signal Selectors (D21 and D22).

ERROR VOLTAGE AMPLIFIER (U10a)

The electric potentials output from the Voltage Divider (R42) and COM electrical potentials are compared and their errors amplified. They are then input into Signal Selectors (D23 and D24).

ERROR VOLTAGE AMPLIFIER (U10b)

The electric potentials output from the Voltage Divider (R43) and COM electrical potentials are compared and their errors amplified. They are then input into Signal Selectors (D25 and D26).

SIGNAL SELECTORS (D19 AND D20) AND SIGNAL AMPLIFIERS (Q1 AND R52)

D19 and D20 constitute cathode commons and signals, either output from U5b or U9a, are selected depending on their potential condition and in turn input into Signal Amplifiers (Q1 and R52). These signals are amplified by Q1 and R52.

SIGNAL SELECTORS (D21 AND D22) AND SIGNAL AMPLIFIERS (Q2 AND R53)

D21 and D22 constitute cathode commons and signals, either output from U6b or U9b, are selected depending on their potential condition and in turn input into Signal Amplifiers (Q2 and R52). These signals are amplified by Q2 and R53.

SIGNAL SELECTORS (D23 AND D24) AND SIGNAL AMPLIFIERS (Q3 AND R54)

D23 and D24 constitute cathode commons and signals, either output from U7b or U10a, are selected depending on their potential condition and in turn input into Signal Amplifiers (Q3 and R54). These signals are amplified by Q3 and R54.

SIGNAL SELECTORS (D25 AND D26) AND SIGNAL AMPLIFIERS (Q4 AND R55)

D25 and D26 constitute cathode commons and signals, either output from U8b or U10b, are selected depending on their potential condition and in turn input into Signal Amplifiers (Q4 and R55). These signals are amplified by Q4 and R55.

CIRCUIT DESCRIPTION

COMPARISON VOLTAGE GENERATORS (R56 - R58)

The reference voltage is generated from +/− 12 V for establishing whether the main power source output is CV or CC. Potentials for +18 V and +8 V power output are negative and are input into Comparators (U11a and U12a) those for −18 V and −6 V power output are positive and are input into comparators (U11b and U12b).

COMPARATORS (U11a, U11b, U12a AND U12b)

A comparison is made between the signals from the Error Current Amplifiers and the Comparison Voltage Generator to establish whether the conditions of each main power source output are CV or CC. The condition of the power output is determined and the corresponding signal is input into the CPU.

REFERENCE VOLTAGE GENERATOR V (U5a, U21, R23, C22 AND C40)

The reference voltage for the +18 V power output is generated by U21, R23, C22 and C40, and led through the buffer constituting U5a. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR V (U6a, U22, R25, C24 AND C41)

The reference voltage for the −18 V power output is generated by U22, R25, C24 and C41, and led through the buffer constituting U6a. This voltage is normally a positive potential.

REFERENCE VOLTAGE GENERATOR V (U7a, U27, AND C26)

The reference voltage for the +8 V power output is generated by R27 and C26 and led through the buffer constituting U7a. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR V (U8a, R29 AND C28)

The reference voltage for the −6 V power output is generated by R29 and C28 and led through the buffer constituting U8a. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR A (R 24 AND C23)

The reference voltage for the +18 V power output is generated by R24 and C23. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR A (R26 AND C25)

The reference voltage for the −18 V power output is generated by R26 and C25. This voltage is normally a positive potential.

REFERENCE VOLTAGE GENERATOR A (R28 AND C27)

The reference voltage for the +8 V power output is generated by R28 and C27. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR A (R30 AND C29)

The reference voltage for the −6 V power output is generated by R30 and C29. This voltage is normally a positive potential.

+/− 18 V TIMING GENERATOR (U25)

Each U21 and U22 functions in a conducting condition in case the +/− 18 V Reference Voltage Generator V becomes reset. With the exception of the above case, signals are sent for keeping a non- conducting condition.

COMPARATORS (U26a, R113 AND R137) AND REFERENCE VOLTAGE GENERATORS (R129 AND R131)

The comparators compare electrical potentials, from Voltage Dividers (R18 and R22), and voltage (approx. +2 V), from Reference Voltage Generators (R129 and R131). They then send ON/OFF signals to the AC Voltage Switch Drive (Q5). U26a carries hysteresis due to R134 and R138.

COMPARATORS (U26b, R134 AND R138) AND REFERENCE VOLTAGE GENERATORS (R130 AND R132)

The comparators compare electrical potentials, from Voltage Dividers (R17 and R21), and voltage (approx. −2 V), from Reference Voltage Generators (R130 and R132). They then send ON/OFF signals to the AC Voltage Switch Drive (Q6). U26b carries hysteresis due to R134 and R138.

NEGATIVE VOLTAGE DETECTION SWITCH [U20 (x)]

One potential, out of four negative potentials detected from voltage dividers of each voltage and current detection sections, becomes selected and sent to the next Voltage Detection switch [U18 (y)]. This switch is controlled by 3 digital signals (D22, D23, and D24)and a non-conductive condition takes effect when selection is being carried out.

POSITIVE VOLTAGE DETECTION SWITCH [U20 (y)]

One potential, out of four positive potentials detected from voltage dividers of each voltage and current detection sections, becomes selected and sent to the next Voltage Detection Switch [U18 (y)]. This switch is controlled by 3 digital signals (D22, D23, and D24) and a non-conductive condition takes effect when selection is being carried out.

D22	D23	D24	Conductivity and selected potential at [U20 (x)]	Conductivity and selected potential at[U20 (y)]
H	—	—	Non-conductivity	Non-conductivity
L	L	L	−18 V potential	+18 V potential
L	H	L	−6 V potential	+8 V potential
L	L	H	+18 V electrical current potential	−18 V electrical current potential
L	H	H	+8 V electrical current potential	−6 V electrical current potential

CIRCUIT DESCRIPTION

VOLTAGE DETECTION SWITCH [U18 (y)]

One electric potential, selected out of potentials output from [U20 (x)], [U20 (y)] or COM, is sent to the Comparator. This switch is controlled by 3 digital signals (D13, D14, and D15) and a non-conductive condition takes effect when selection is being carried out.

D13	D14	D15	Conductivity and selected potential
H	—	—	Non-conductivity
L	L	L	U20 (x) potential
L	H	L	U20 (y) potential
L	L	H	COM potential
L	H	H	COM potential

+/− REFERENCE VOLTAGE GENERATOR DAC (U4, U17, D4, R8 - R13, AND R75 - R82)

All reference voltages for the power source are generated here. U17 constitutes a 12 bit electric current output type DAC. Current-to-voltage conversion is carried out in U4a and U4b. Positive potentials are generated in U4a while negative ones are generated in U4b. The digital signals used in DAC are D1 - D12. This DAC, however, can be easily used as a 14 bit DAC with an addition of 2 bits, digital signals D16, D21, and R75 - R82, on the LSB side. The reference voltage for AMP U4a and U4b, for +/− electric current to voltage conversion, becomes generated by D4 and R8 - R13.

Input digital signal	000H	3FFFH
Generated + Voltage TYP value	−186 mV	+3,910 V
Generated − Voltage TYP value	+176 mV	−3,920 V

REFERENCE VOLTAGE SWITCH [U18 (x)]

Either the +/− reference voltage output from U4a or U4b is selected and input into the next Reference Voltage Switch (U19) or the Comparator (U16). This switch is controlled by 3 digital signals (D13, D14, and D15) and a non-conductive condition takes effect when selection is being carried out.

D13	D14	D15	Conductivity & selected potential
H	—	—	Non-conductivity
L	L	L	Negative reference voltage
L	H	L	Positive reference voltage
L	L	H	Negative reference voltage
L	H	H	Positive reference voltage

REFERENCE VOLTAGE SWITCH (U19)

A signal output from U18 is input into one of the 8 Reference Voltage Generators V and A. This switch is controlled by 4 digital signals (D17, D18, D19, or D20) and a non-conductive condition takes effect when selection is being carried out.

D17	D18	D19	D20	Conductivity and destination of signal
H	—	—	—	Non-conductivity
L	L	L	L	+18 V Reference Voltage Generator
L	H	L	L	+18 A Reference Voltage Generator
L	L	H	L	−18 V Reference Voltage Generator
L	H	H	L	−18 A Reference Voltage Generator
L	L	L	H	+ 8 V Reference Voltage Generator
L	H	L	H	+ 8 A Reference Voltage Generator
L	L	H	H	− 6 V Reference Voltage Generator
L	H	H	H	− 6 A Reference Voltage Generator

COMPARATOR (U16)

A comparison is made on the potentials of signals sent from [U18 (x) and (y)] and determined data is sent to the CPU via the Signal Converter. Overall speaking, data is output following successive comparison.

Determined data	Signals from [U18 (x)]	Signals from [U18 (y)]
Detection of + reference voltage OV data	+ reference voltage	COM potential
Detection of − reference voltage OV data	− reference voltage	COM potential
Detection of +18 V potential value	+ reference voltage	Voltage divider (R18, R22)
Detection of +18 A potential value	− reference voltage	Voltage divider (VR3, R63)
Detection of −18 V potential value	+ reference voltage	Voltage divider (R17, R21)
Detection of −18 A potential value	− reference voltage	Voltage divider (VR4, R64)
Detection of +8 V potential value	+ reference voltage	Voltage divider (R16, R20)
Detection of +8 A potential value	− reference voltage	Voltage divider (VR5, R65)
Detection of −6 V potential value	+ reference voltage	Voltage divider (R15, R19)
Detection of −6 V potential value	− reference voltage	Voltage divider (VR6, R66)

CIRCUIT DESCRIPTION

In order to minimize offset error in U16a, U16b is used as a buffer and offset error becomes canceled throughout U16.

SIGNAL CONVERTER (D5 AND R14)

The +/− 12 V signals sent from U16 and -12 V signals sent from D5 and R14 become converted and sent to the CPU.

DATA LATCH (U13, U14, AND U15)

The 24 bit data sent to the serial from the CPU are serial parallel converted and output as 24 bit parallel data.

ISOLATOR AND +5 V GENERATOR

The CPU and AMP are electrically isolated and signals between them are transmitted using photo couplers in U103, U105 and U106.

The power source for the CPU side is +5 V generated in D101, C101, and U101.

NOISE SUPPRESSOR

In an effort to prevent noise, the CPU and Panel are equipped inside a shielded case. There is some noise, however, that passes through the line of transmission between the CPU and Isolator. Such line noise is removed by the application of through type condensers on 12 lines, including the power source line.

CPU

The microcomputer uses a Z80 chip and has a clock speed of 4 MHz. A watch dog timer (U5 and C5) is used to prevent any run away (speeding) by the computer.

KEYBOARD INPUT, ROTARY ENCODER INPUT, INPUT PORT, AND INTERRUPT

When any of the keys (S51 - S63) are , pressed, the output of U55 becomes "L" and the CPU is interrupted. The pressed key becomes decided by signals (2 lines) from Output Port U53 and from Input Port U54. When the rotary encoder is operated, the collector potential of either Q62 or Q63 becomes "L", i.e. passing through the sequence U57e → U57f → U56, and this potential interrupts the CPU. The Rotary Encoder counts within a given time pass through U57a and U57b, and is input into the CPU via Input Port U7. As for the up/down decision of the encoder, data sent to the CPU via Input Port U7 is decided. This is because the Q output of U56a and U56b falls to "L", when data from the encoder first interrupts the CPU, and this state is maintained. Besides data from the keyboard or the rotary encoder, 3 types of data from the AMP and isolator are input into the Input Port U7 and U10. These data are different from those for the previously mentioned interrupt input. They are periodically read out by the CPU within the program loop, reaching the CPU via the Input Port U7 and U10.

Details of the said data are as a following:
(1) Comparative U14 data (Successive comparison data)
(2) Positive output data (CC state at "L")
(3) Negative output data (CC state at "L")

OUTPUT PORT

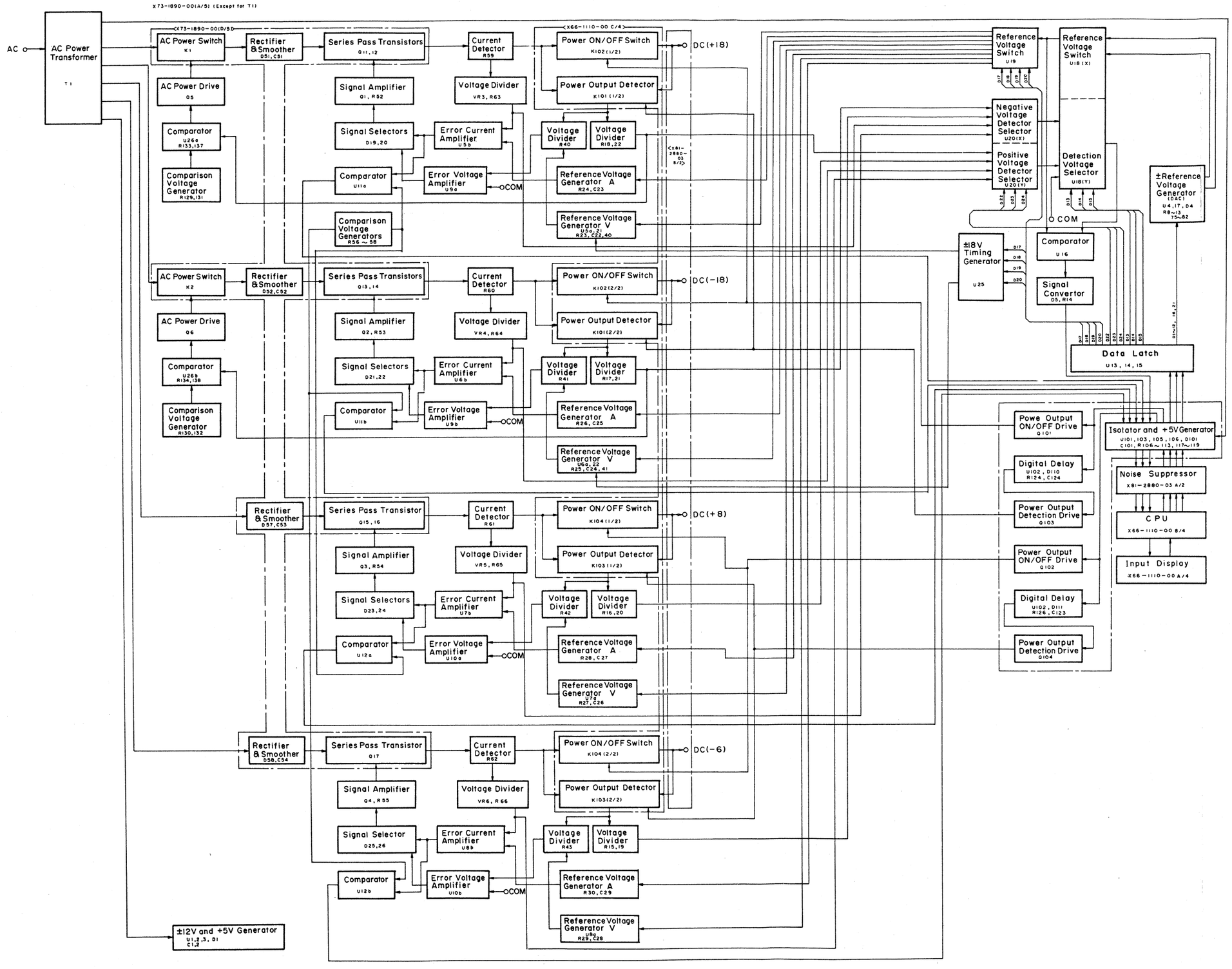
- The 2 pieces of data at Output Port U53 are normally "H". As previously mentioned, pressing any key (S51 - S63) turns either of the above data to "L" while the other remains "Hå00. After data of the opposite nature is output, the key input becomes a decided.
- 5 pieces of data at Output Port U53 are used as control signals for the Display Drive.
- 3 pieces of data are sent to the AMP digital data generator from Output Port U53 via the Isolator.

The above data are as the following :
(1) 24 bit serial data
(2) 24 bit serial data shift clock data
(3) 24 bit serial data latch clock data
Data of above (2) are digital delayed through U1a, U1d, R136, C62, and D3. They are then sent to the digital data generator via the isolator. This action also compensates for any lag in the response time of the isolator's photo coupler.

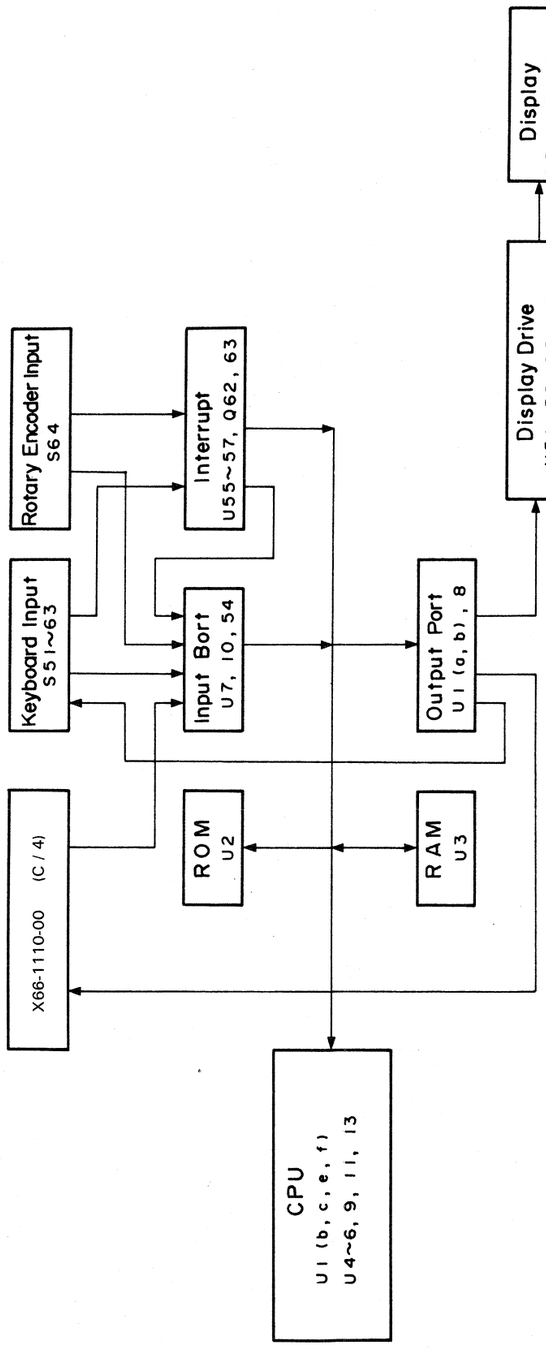
DISPLAY DRIVE AND DISPLAY

Both U51 and U52 are ICs for dynamic blinking lights. Transmitters (R83 and C60, R84 and C61, respectively) are equipped. The display is controlled by the previously mentioned 4 pieces of data from U53.

BLOCK DIAGRAM


X73-1890-001A/5) (Except for T1)
AC
AC Power Transformer
T1
X73-1890-001D/5)
AC Power Switch K1
Rectifier & Smoother D51, C51
Series Pass Transistors Q11, 12
Current Detector R59
Power ON/OFF Switch K102(1/2)
DC(+18)
AC Power Drive Q5
Signal Amplifier Q1, R52
Voltage Divider VR3, R63
Power Output Detector K101 (1/2)
Comparator U26a R133, 137
Signal Selectors D19, 20
Error Current Amplifier U5b
Voltage Divider R40
Voltage Divider R18, 22
Comparison Voltage Generator R129, 131
Comparator U11a
Error Voltage Amplifier U9a
COM
Reference Voltage Generator A R24, C23
Reference Voltage Generator V U56, 21 R23, C22, 40
Comparison Voltage Generators R56 ~ 58
AC Power Switch K2
Rectifier & Smoother D52, C52
Series Pass Transistors Q13, 14
Current Detector R60
Power ON/OFF Switch K102(2/2)
DC(−18)
AC Power Drive Q6
Signal Amplifier Q2, R53
Voltage Divider VR4, R64
Power Output Detector K101(2/2)
Comparator U26b R134, 138
Signal Selectors D21, 22
Error Current Amplifier U6b
Voltage Divider R41
Voltage Divider R17, 21
Comparison Voltage Generator R130, 132
Comparator U11b
Error Voltage Amplifier U9b
COM
Reference Voltage Generator A R26, C25
Reference Voltage Generator V U56, 22 R25, C24, 41
Rectifier & Smoother D57, C53
Series Pass Transistor Q15, 16
Current Detector R61
Power ON/OFF Switch K104(1/2)
DC(+8)
Signal Amplifier Q3, R54
Voltage Divider VR5, R65
Power Output Detector K103(1/2)
Signal Selectors D23, 24
Error Current Amplifier U7b
Voltage Divider R42
Voltage Divider R16, 20
Comparator U12a
Error Voltage Amplifier U10a
COM
Reference Voltage Generator A R28, C27
Reference Voltage Generator V U72 R27, C26
Rectifier & Smoother D58, C54
Series Pass Transistor Q17
Current Detector R62
Power ON/OFF Switch K104(2/2)
DC(−6)
Signal Amplifier Q4, R55
Voltage Divider VR6, R66
Power Output Detector K103(2/2)
Signal Selector D25, 26
Error Current Amplifier U8b
Voltage Divider R43
Voltage Divider R15, 19
Comparator U12b
Error Voltage Amplifier U10b
COM
Reference Voltage Generator A R30, C29
Reference Voltage Generator V U82 R29, C28
±12V and +5V Generator U1, 2, 3, D1 C1, 2
X66-1110-00 C/4
X81-2880-03 B/5
Reference Voltage Switch U19
Reference Voltage Switch U18 (X)
Negative Voltage Detector Selector U20(X)
Positive Voltage Detector Selector U20(Y)
Detection Voltage Selector U18(Y)
±Reference Voltage Generator (DAC) U4, 17, D4 R8~13 75~82
COM
±8V Timing Generator U25
Comparator U16
Signal Convertor D5, R14
Data Latch U13, 14, 15
Powe Output ON/OFF Drive Q101
Digital Delay U102, D110 R124, C124
Power Output Detection Drive Q103
Power Output ON/OFF Drive Q102
Digital Delay U102, D111 R126, C123
Power Output Detection Drive Q104
Isolator and +5V Generator U101, 103, 105, 106, D101 C101, R106~113, 117~119
Noise Suppressor X81-2880-03 A/2
C P U X66-1110-00 B/4
Input Display X66-1110-00 A/4

BLOCK DIAGRAM



ADJUSTMENT

To obtain the best performance, periodically calibrate the unit. Sometimes, only one mode need be calibrated, while at other times, all modes should be calibrated. When one mode is calibrated, it must be noted that the other modes may be affected. When calibrating all modes, perform the calibration in the specified sequence.

The following calibration required an accurate measuring instrument and an insulated adjusting flat blade screwdriver. If they are not available, contact your dealer. For optimum adjustment, turn the power on and warm up the scope sufficiently (more than 30 minutes) before starting.

Before calibrating the unit, check the power supply voltage.

TEST EQUIPMENT REQUIRED

The following instrument or their equivalent should be used for making adjustment.

Multimeter	45	FLUKE
Oscilloscope	CS-4025	KENWOOD

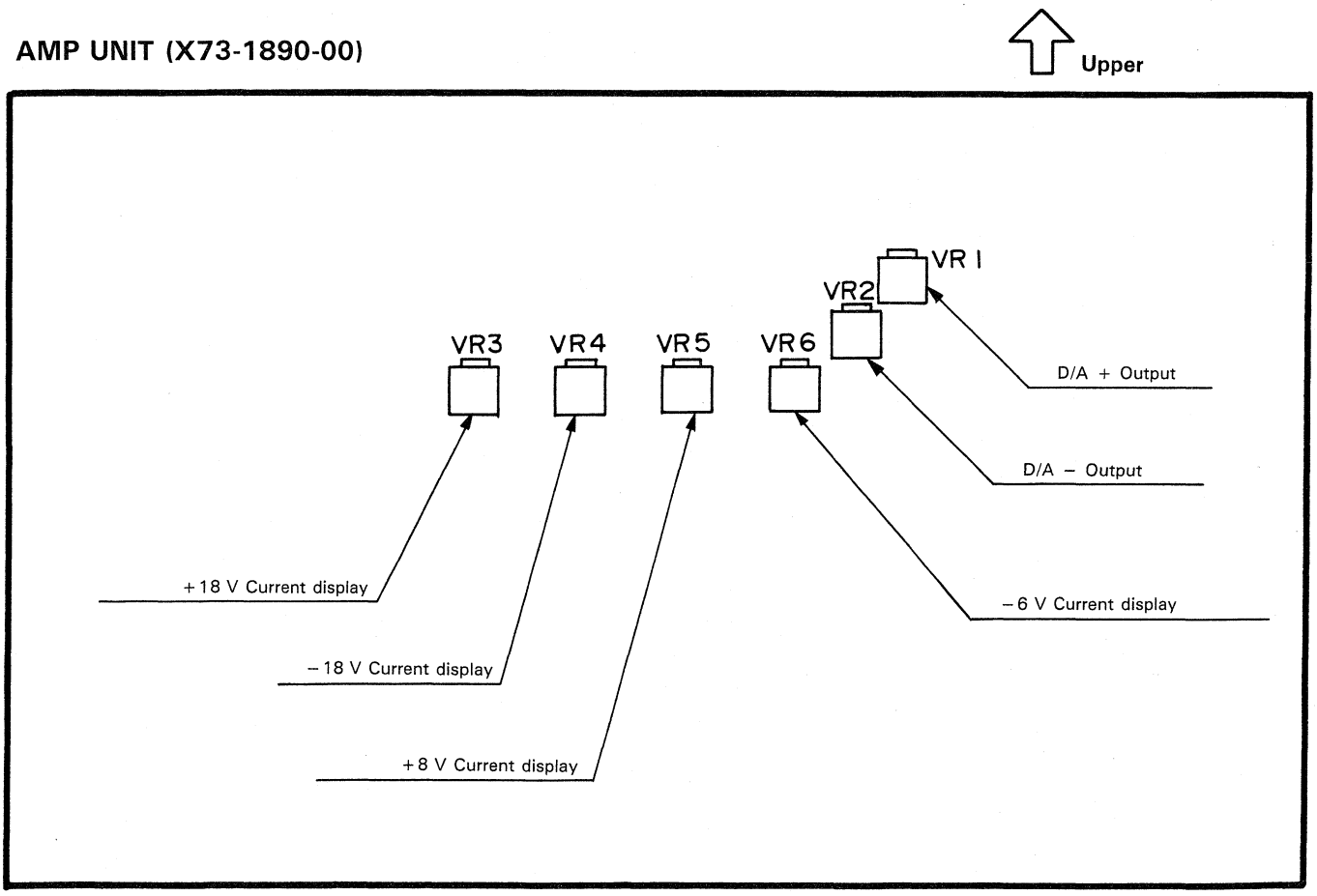
ADJUSTMENT

Item	Adjustment VR	Procedure
D/A + Output	VR1	1. Connect the multimeter as follows: Multimeter — PW + to X73-1890 TP COM to COM terminal on the panel At this point, set the multimeter to the voltage measurement mode. 2. Set the PW to the voltage adjustment mode. Turn the power switch ON pressing the KEYLOCK switch. Set the KEYLOCK switch free when the LEDs go on. At this point, all the 7-segment LEDs display "8". 3. Press the PRESET1 and observe the multimeter. Assume that the value at this point is P. 4. Press the PRESET2. Then adjust the VR1 so that the multimeter indicates (P+4.096) V. ±2mV
D/A − Output	VR2	1. Press the PRESET3 and observe the multimeter. Assume that the value at this point is Q. 2. Press the VARIABLE. Then adjust the VR2 so that the multimeter indicates (Q+4.096) V. ±2mV 3. Cancel the voltage adjustment mode by pressing the V switch. (Cancellation will take about 10 seconds.)
+18 V Current Display	VR3	1. Connect the multimeter as follows: Multimeter — PW + to +18 V terminal on the panel COM to COM terminal on the panel At this point, set the multimeter to the current measurement mode. 2. Turn the OUTPUT switch ON. Then adjust the multimeter by turning the rotary knob so that it indicates 1.80 A. At this point, make sure that the +18 V LED blinks and the unit maintains a constant current. 3. Adjust the VR3 so that the multimeter indicates 1.80 A.
−18 V Current Display	VR4	1. Connect the multimeter as follows: Multimeter — PW + to −18 V terminal on the panel COM to COM terminal on the panel At this point, set the multimeter to the current measurement mode. 2. Display −18 V on the 7-segment LED by pressing the −18 V switch. 3. Turn the OUTPUT switch ON. Then adjust the multimeter by turning the rotary knob so that it indicates −1.80 A. At this point, make sure that the −18 V LED blinks and the unit maintains a constant current. 4. Adjust the VR4 so that the multimeter indicates −1.80 A.

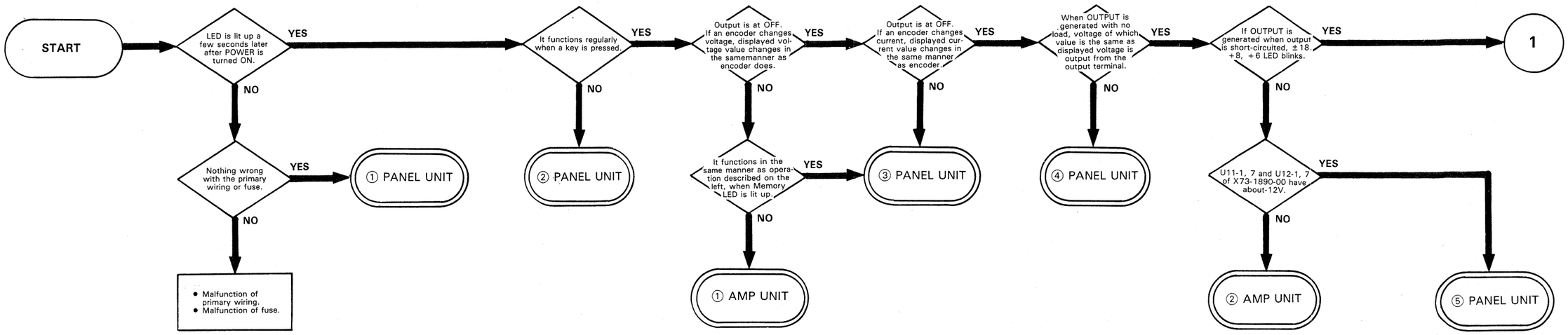
ADJUSTMENT

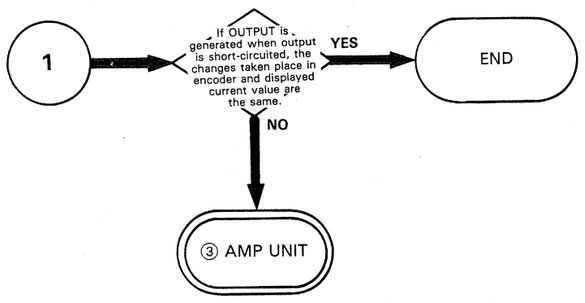
Item	Adjustment VR	Procedure
+8 V Current Display	VR5	1. Connect the multimeter as follows: Multimeter PW + to +8 V terminal on the panel COM to COM terminal on the panel At this point, set the multimeter to the current measurement mode. 2. Display +8 V on the 7-segment LED by pressing the +8 V switch. 3. Turn the OUTPUT switch ON. Then adjust the multimeter by turning the rotary knob so that it indicates 2.00 A. At this point, make sure that the +8 V LED blinks and the unit maintains a constant current. 4. Adjust the VR5 so that the multimeter indicates 2.00 A.
−6 V Current Display	VR6	1. Connect the multimeter as follows: Multimeter PW + to −6 V terminal on the panel COM to COM terminal on the panel At this point, set the multimeter to the current measurement mode. 2. Display −6 V on the 7-segment LED by pressing the −6 V switch. 3. Turn the OUTPUT switch ON. Then adjust the multimeter by turning the rotary knob so that it indicates −1.00 A. At this point, make sure that the −6 V LED blinks and the unit maintains a constant current. 4. Adjust the VR6 so that the multimeter indicates −1.00 A.

AMP UNIT (X73-1890-00)

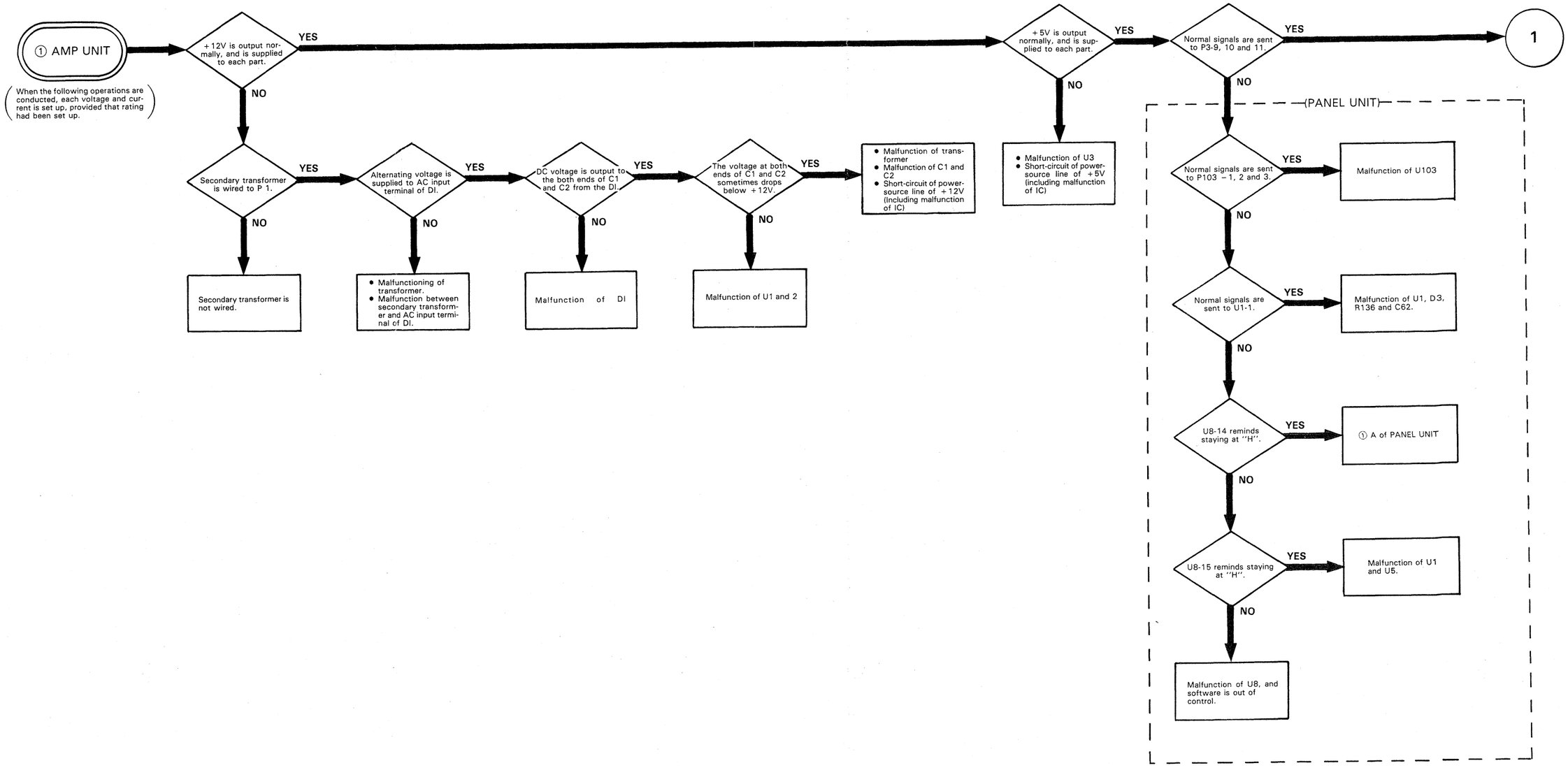


TROUBLESHOOTING

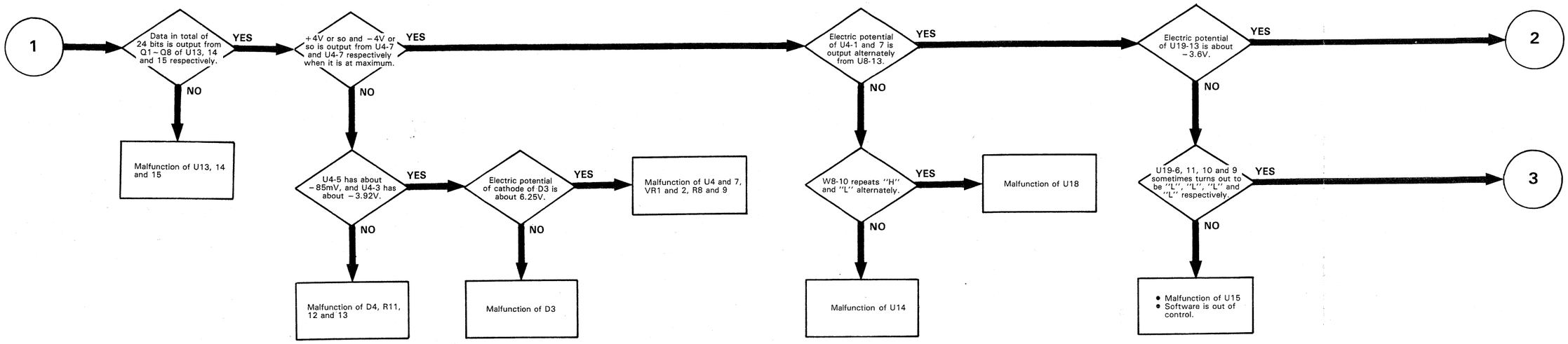

START
LED is lit up a few seconds later after POWER is turned ON.
YES
NO
Nothing wrong with the primary wiring or fuse.
YES
① PANEL UNIT
NO
• Malfunction of primary wiring.
• Malfunction of fuse.
It functions regularly when a key is pressed.
YES
NO
② PANEL UNIT
Output is at OFF. If an encoder changes voltage, displayed voltage value changes in the samemanner as encoder does.
YES
NO
It functions in the same manner as operation described on the left, when Memory LED is lit up.
YES
③ PANEL UNIT
NO
① AMP UNIT
Output is at OFF. If an encoder changes current, displayed current value changes in the same manner as encoder.
YES
NO
When OUTPUT is generated with no load, voltage of which value is the same as displayed voltage is output from the output terminal.
YES
NO
④ PANEL UNIT
If OUTPUT is generated when output is short-circuited, ±18, +8, +6 LED blinks.
YES
NO
U11-1, 7 and U12-1, 7 of X73-1890-00 have about-12V.
YES
NO
② AMP UNIT
⑤ PANEL UNIT
1

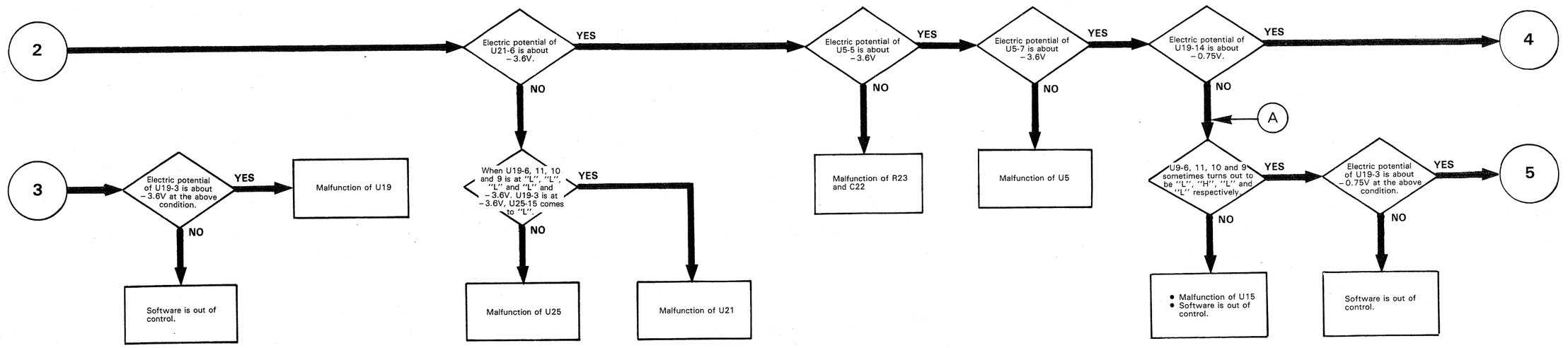

1
If OUTPUT is generated when output is short-circuited, the changes taken place in encoder and displayed current value are the same.
YES
END
NO
③ AMP UNIT

TROUBLESHOOTING

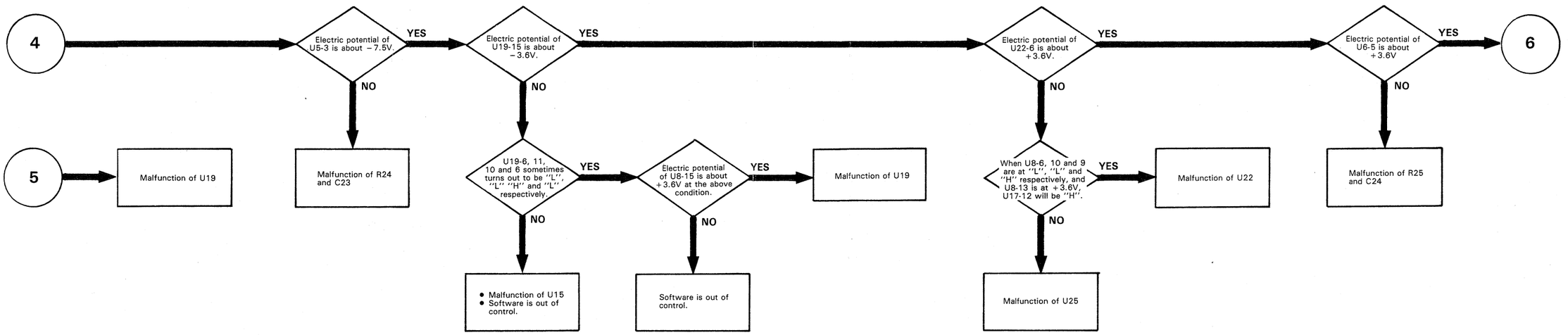

① AMP UNIT
When the following operations are conducted, each voltage and current is set up, provided that rating had been set up.
+12V is output normally, and is supplied to each part.
YES
NO
Secondary transformer is wired to P 1.
YES
NO
Secondary transformer is not wired.
Alternating voltage is supplied to AC input terminal of DI.
YES
NO
• Malfunctioning of transformer.
• Malfunction between secondary transformer and AC input terminal of DI.
DC voltage is output to the both ends of C1 and C2 from the DI.
YES
NO
Malfunction of DI
The voltage at both ends of C1 and C2 sometimes drops below +12V.
YES
NO
Malfunction of U1 and 2
• Malfunction of transformer
• Malfunction of C1 and C2
• Short-circuit of power-source line of +12V (Including malfunction of IC)
+5V is output normally, and is supplied to each part.
YES
NO
• Malfunction of U3
• Short-circuit of power-source line of +5V (including malfunction of IC)
Normal signals are sent to P3-9, 10 and 11.
YES
NO
1
(PANEL UNIT)
Normal signals are sent to P103 – 1, 2 and 3.
YES
NO
Malfunction of U103
Normal signals are sent to U1-1.
YES
NO
Malfunction of U1, D3, R136 and C62.
U8-14 reminds staying at "H".
YES
NO
① A of PANEL UNIT
U8-15 reminds staying at "H".
YES
NO
Malfunction of U1 and U5.
Malfunction of U8, and software is out of control.

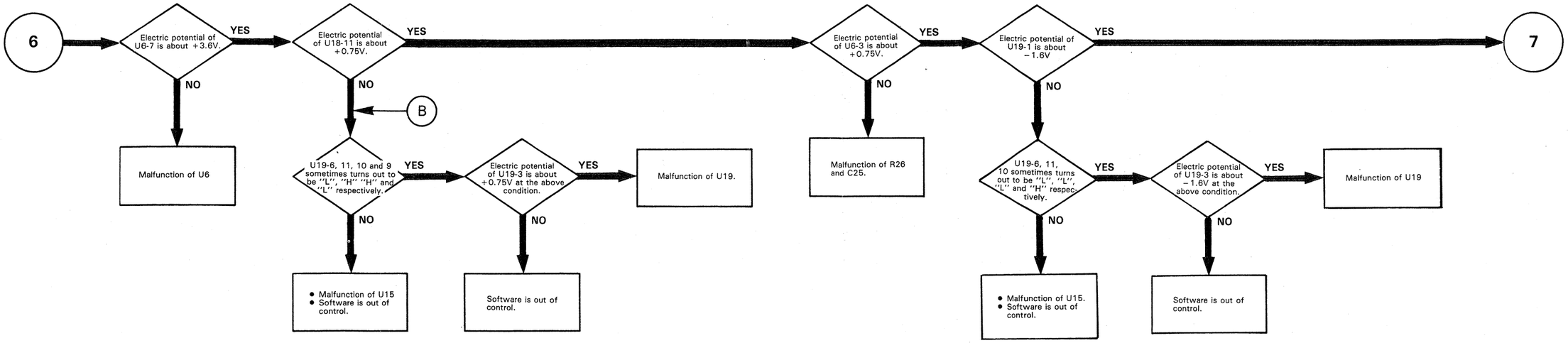
TROUBLESHOOTING


1
Data in total of 24 bits is output from Q1 – Q8 of U13, 14 and 15 respectively.
YES
NO
Malfunction of U13, 14 and 15
+4V or so and –4V or so is output from U4-7 and U4-7 respectively when it is at maximum.
YES
NO
U4-5 has about –85mV, and U4-3 has about –3.92V.
YES
NO
Electric potential of cathode of D3 is about 6.25V.
YES
NO
Malfunction of U4 and 7, VR1 and 2, R8 and 9
Malfunction of D4, R11, 12 and 13
Malfunction of D3
Electric potential of U4-1 and 7 is output alternately from U8-13.
YES
NO
W8-10 repeats "H" and "L" alternately.
YES
NO
Malfunction of U18
Malfunction of U14
Electric potential of U19-13 is about –3.6V.
YES
NO
2
U19-6, 11, 10 and 9 sometimes turns out to be "L", "L", "L" and "L" respectively.
YES
NO
3
• Malfunction of U15
• Software is out of control.

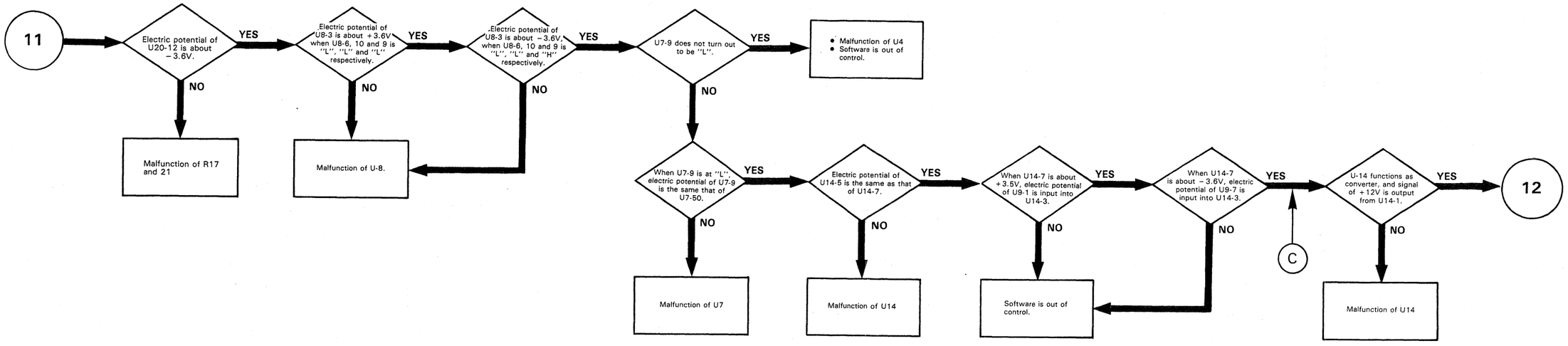


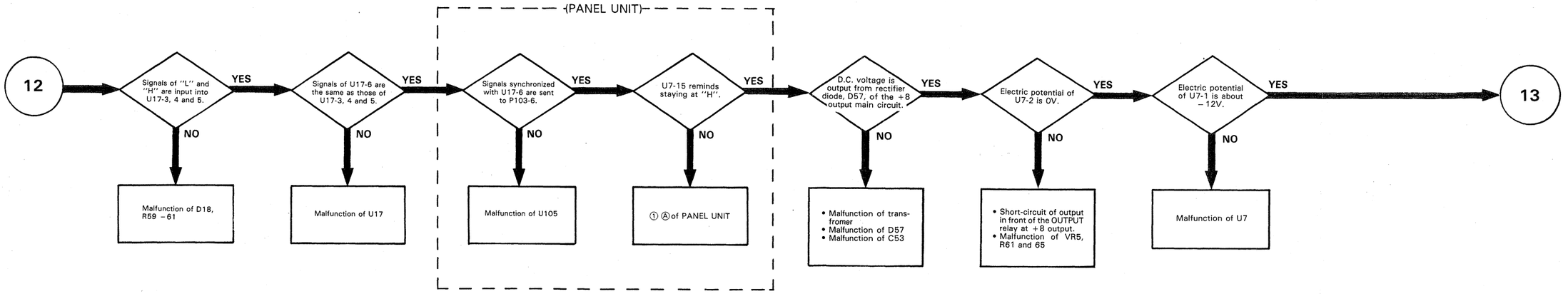
TROUBLESHOOTING



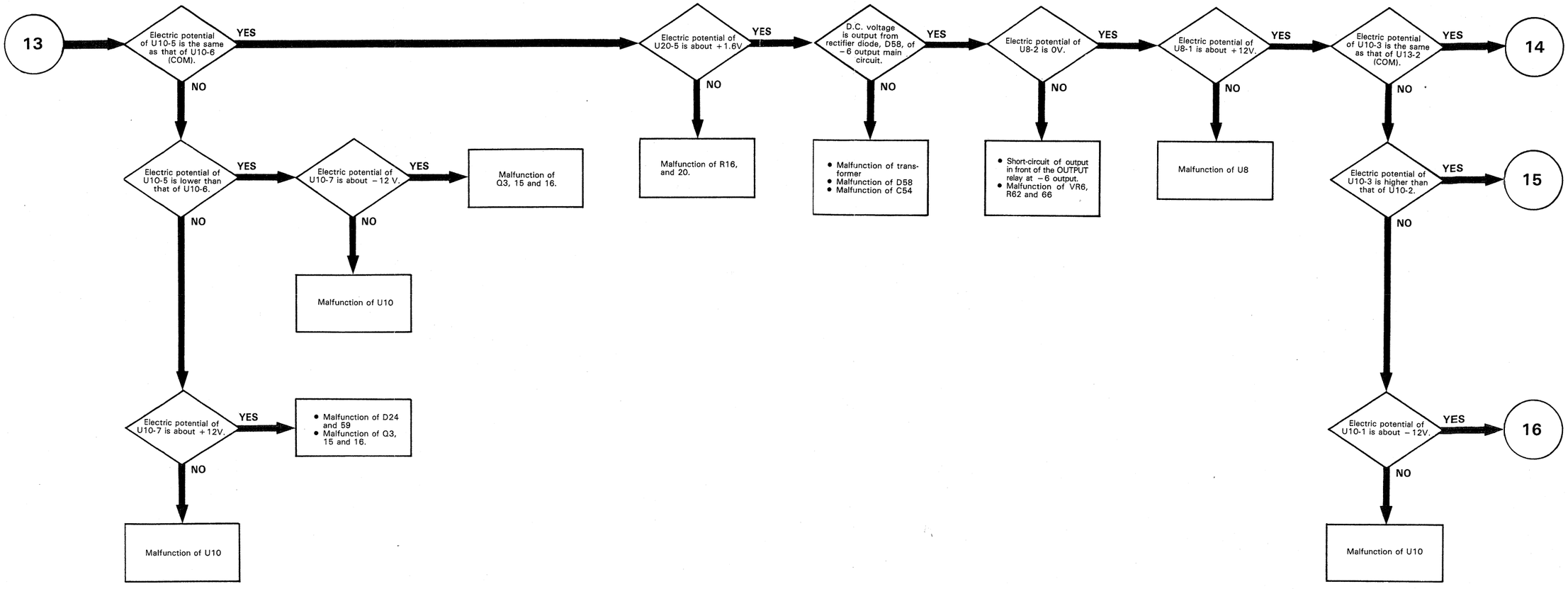


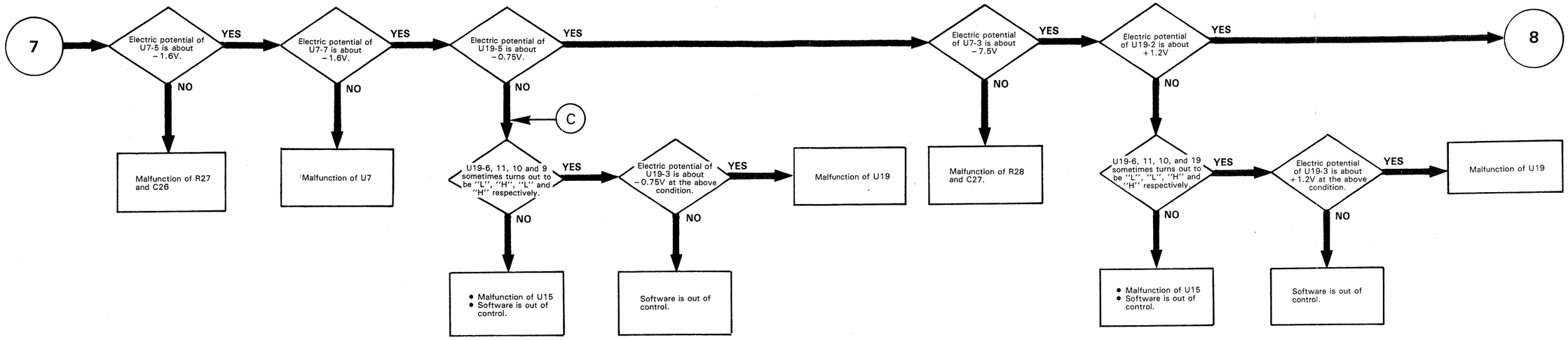
TROUBLESHOOTING

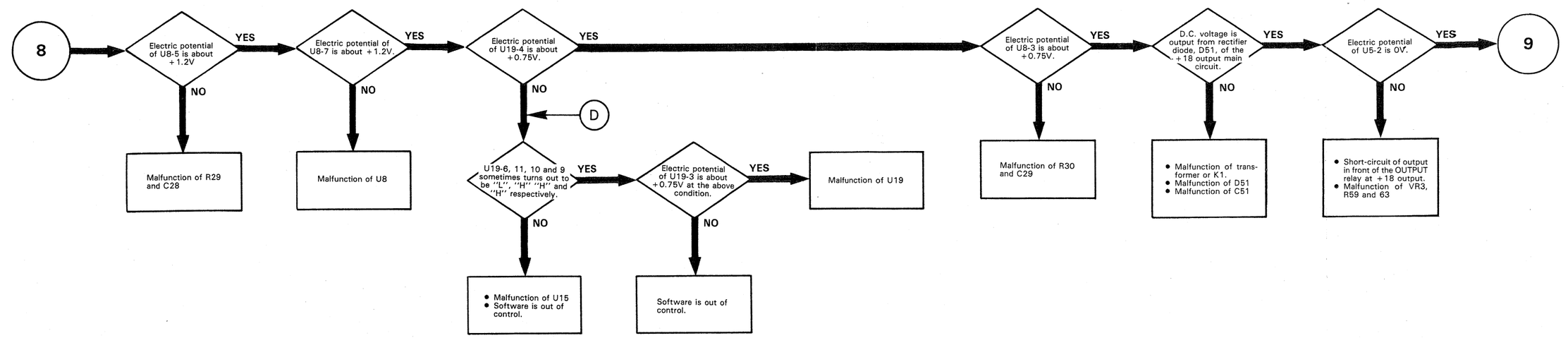

11
Electric potential of U20-12 is about −3.6V.
YES
NO
Malfunction of R17 and 21
Electric potential of U8-3 is about +3.6V when U8-6, 10 and 9 is "L", "L" and "L" respectively.
YES
NO
Malfunction of U-8.
Electric potential of U8-3 is about −3.6V, when U8-6, 10 and 9 is "L", "L" and "H" respectively.
YES
NO
U7-9 does not turn out to be "L".
YES
• Malfunction of U4
• Software is out of control.
NO
When U7-9 is at "L", electric potential of U7-9 is the same that of U7-50.
YES
NO
Malfunction of U7
Electric potential of U14-5 is the same as that of U14-7.
YES
NO
Malfunction of U14
When U14-7 is about +3.5V, electric potential of U9-1 is input into U14-3.
YES
NO
Software is out of control.
When U14-7 is about −3.6V, electric potential of U9-7 is input into U14-3.
YES
NO
C
U-14 functions as converter, and signal of +12V is output from U14-1.
YES
NO
Malfunction of U14
12


12
Signals of "L" and "H" are input into U17-3, 4 and 5.
YES
NO
Malfunction of D18, R59 − 61
Signals of U17-6 are the same as those of U17-3, 4 and 5.
YES
NO
Malfunction of U17
(PANEL UNIT)
Signals synchronized with U17-6 are sent to P103-6.
YES
NO
Malfunction of U105
U7-15 reminds staying at "H".
YES
NO
① Ⓐ of PANEL UNIT
D.C. voltage is output from rectifier diode, D57, of the +8 output main circuit.
YES
NO
• Malfunction of transfromer
• Malfunction of D57
• Malfunction of C53
Electric potential of U7-2 is 0V.
YES
NO
• Short-circuit of output in front of the OUTPUT relay at +8 output.
• Malfunction of VR5, R61 and 65
Electric potential of U7-1 is about −12V.
YES
NO
Malfunction of U7
13

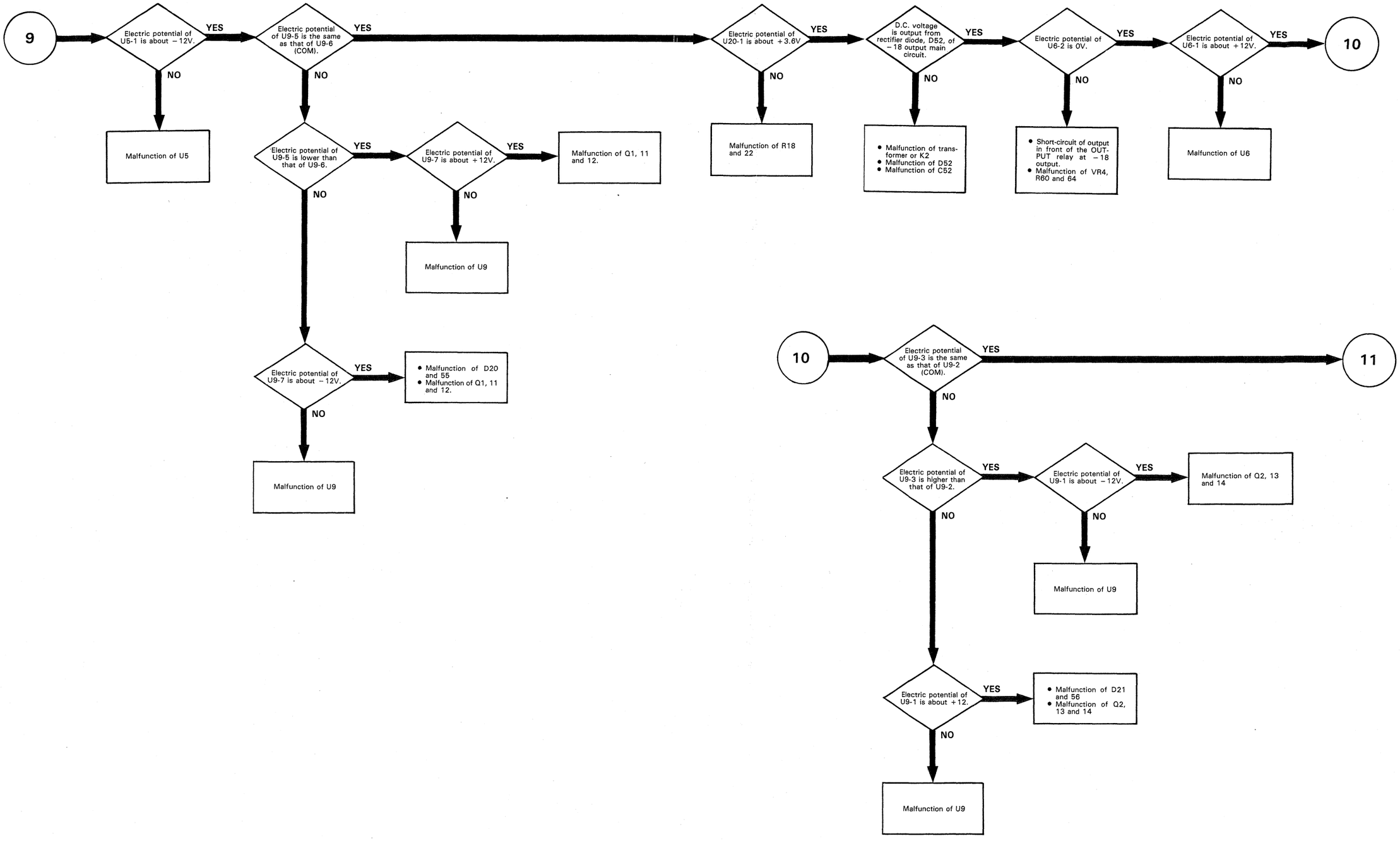
TROUBLESHOOTING


13
Electric potential of U10-5 is the same as that of U10-6 (COM).
YES
NO
Electric potential of U10-5 is lower than that of U10-6.
YES
Electric potential of U10-7 is about − 12 V.
YES
Malfunction of Q3, 15 and 16.
NO
Malfunction of U10
Electric potential of U10-7 is about + 12V.
YES
• Malfunction of D24 and 59
• Malfunction of Q3, 15 and 16.
NO
Malfunction of U10
Electric potential of U20-5 is about + 1.6V.
YES
NO
Malfunction of R16, and 20.
D.C. voltage is output from rectifier diode, D58, of − 6 output main circuit.
YES
NO
• Malfunction of transformer
• Malfunction of D58
• Malfunction of C54
Electric potential of U8-2 is 0V.
YES
NO
• Short-circuit of output in front of the OUTPUT relay at − 6 output.
• Malfunction of VR6, R62 and 66
Electric potential of U8-1 is about + 12V.
YES
NO
Malfunction of U8
Electric potential of U10-3 is the same as that of U13-2 (COM).
YES
14
NO
Electric potential of U10-3 is higher than that of U10-2.
YES
15
NO
Electric potential of U10-1 is about − 12V.
YES
16
NO
Malfunction of U10

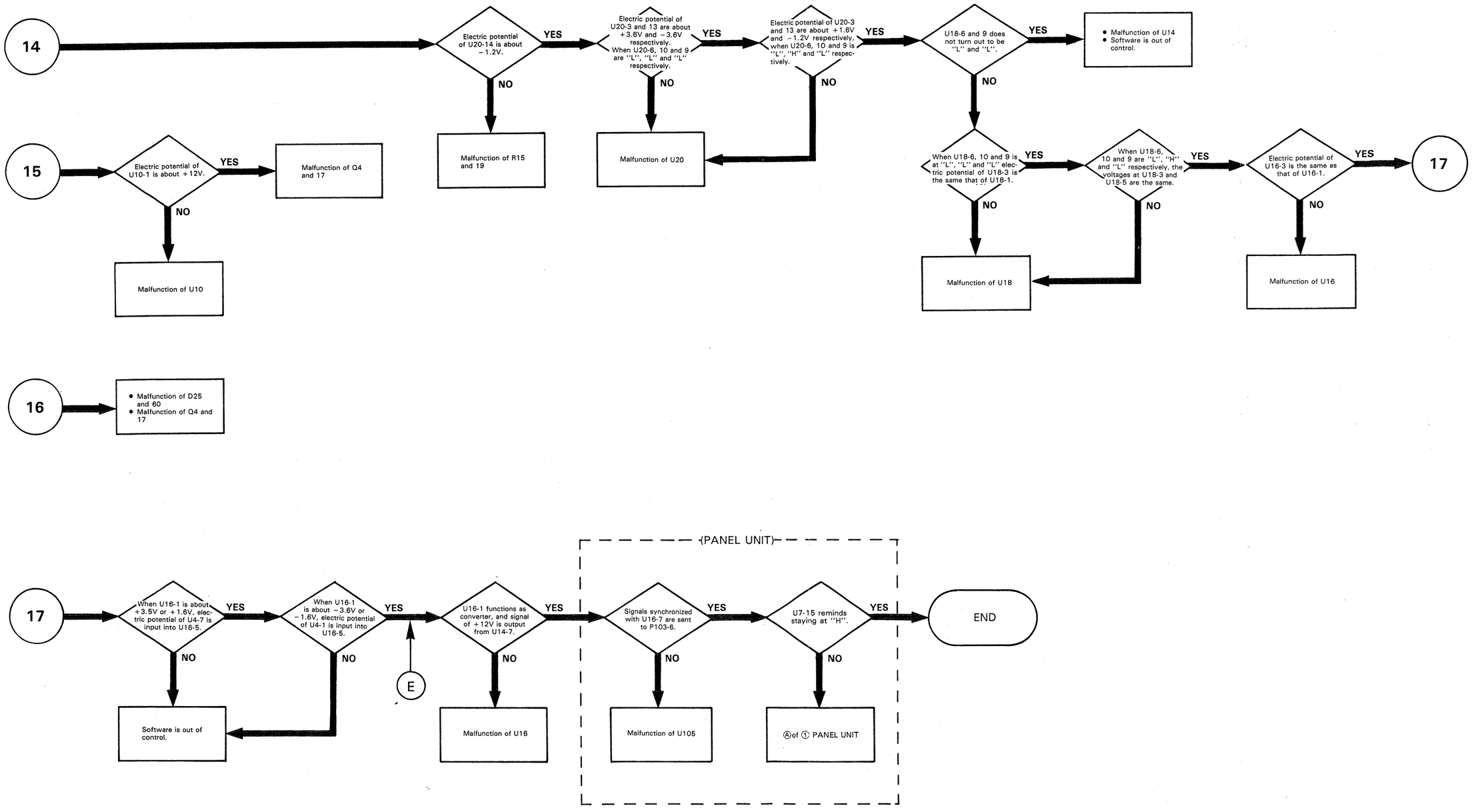

7
Electric potential of U7-5 is about −1.6V.
YES
NO
Malfunction of R27 and C26
Electric potential of U7-7 is about −1.6V.
YES
NO
Malfunction of U7
Electric potential of U19-5 is about −0.75V.
YES
NO
C
U19-6, 11, 10 and 9 sometimes turns out to be "L", "H", "L" and "H" respectively.
YES
NO
• Malfunction of U15
• Software is out of control.
Electric potential of U19-3 is about −0.75V at the above condition.
YES
NO
Software is out of control.
Malfunction of U19
Electric potential of U7-3 is about −7.5V
YES
NO
Malfunction of R28 and C27.
Electric potential of U19-2 is about +1.2V
YES
NO
U19-6, 11, 10, and 19 sometimes turns out to be "L", "L", "H" and "H" respectively.
YES
NO
• Malfunction of U15
• Software is out of control.
Electric potential of U19-3 is about +1.2V at the above condition.
YES
NO
Software is out of control.
Malfunction of U19
8


8
Electric potential of U8-5 is about +1.2V
YES
NO
Malfunction of R29 and C28
Electric potential of U8-7 is about +1.2V.
YES
NO
Malfunction of U8
Electric potential of U19-4 is about +0.75V.
YES
NO
D
U19-6, 11, 10 and 9 sometimes turns out to be "L", "H" "H" and "H" respectively.
YES
NO
• Malfunction of U15
• Software is out of control.
Electric potential of U19-3 is about +0.75V at the above condition.
YES
NO
Software is out of control.
Malfunction of U19
Electric potential of U8-3 is about +0.75V.
YES
NO
Malfunction of R30 and C29
D.C. voltage is output from rectifier diode, D51, of the +18 output main circuit.
YES
NO
• Malfunction of transformer or K1.
• Malfunction of D51
• Malfunction of C51
Electric potential of U5-2 is 0V.
YES
NO
• Short-circuit of output in front of the OUTPUT relay at +18 output.
• Malfunction of VR3, R59 and 63
9

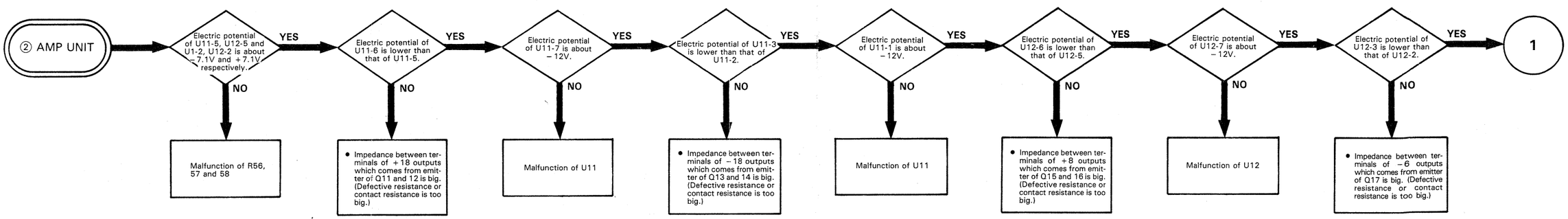
TROUBLESHOOTING

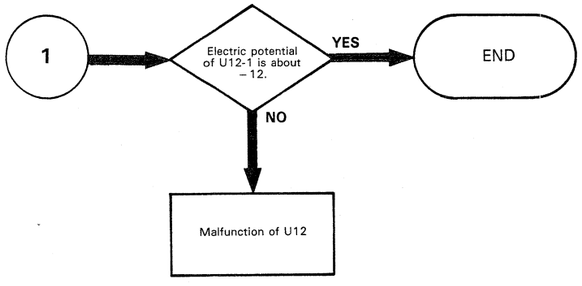

9
Electric potential of U5-1 is about − 12V.
YES
NO
Malfunction of U5
Electric potential of U9-5 is the same as that of U9-6 (COM).
YES
NO
Electric potential of U9-5 is lower than that of U9-6.
YES
NO
Electric potential of U9-7 is about + 12V.
YES
NO
Malfunction of Q1, 11 and 12.
Malfunction of U9
Electric potential of U9-7 is about − 12V.
YES
NO
• Malfunction of D20 and 55
• Malfunction of Q1, 11 and 12.
Malfunction of U9
Electric potential of U20-1 is about + 3.6V
YES
NO
Malfunction of R18 and 22
D.C. voltage is output from rectifier diode, D52, of − 18 output main circuit.
YES
NO
• Malfunction of transformer or K2
• Malfunction of D52
• Malfunction of C52
Electric potential of U6-2 is 0V.
YES
NO
• Short-circuit of output in front of the OUTPUT relay at − 18 output.
• Malfunction of VR4, R60 and 64
Electric potential of U6-1 is about + 12V.
YES
NO
Malfunction of U6
10
10
Electric potential of U9-3 is the same as that of U9-2 (COM).
YES
NO
Electric potential of U9-3 is higher than that of U9-2.
YES
NO
Electric potential of U9-1 is about − 12V.
YES
NO
Malfunction of Q2, 13 and 14
Malfunction of U9
Electric potential of U9-1 is about + 12.
YES
NO
• Malfunction of D21 and 56
• Malfunction of Q2, 13 and 14
Malfunction of U9
11

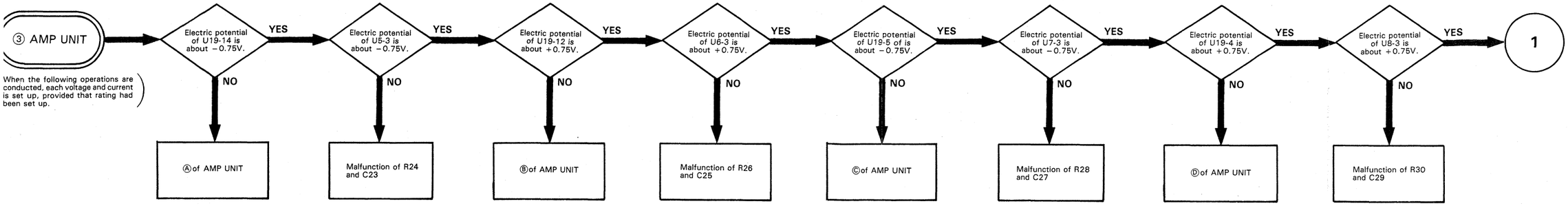
TROUBLESHOOTING

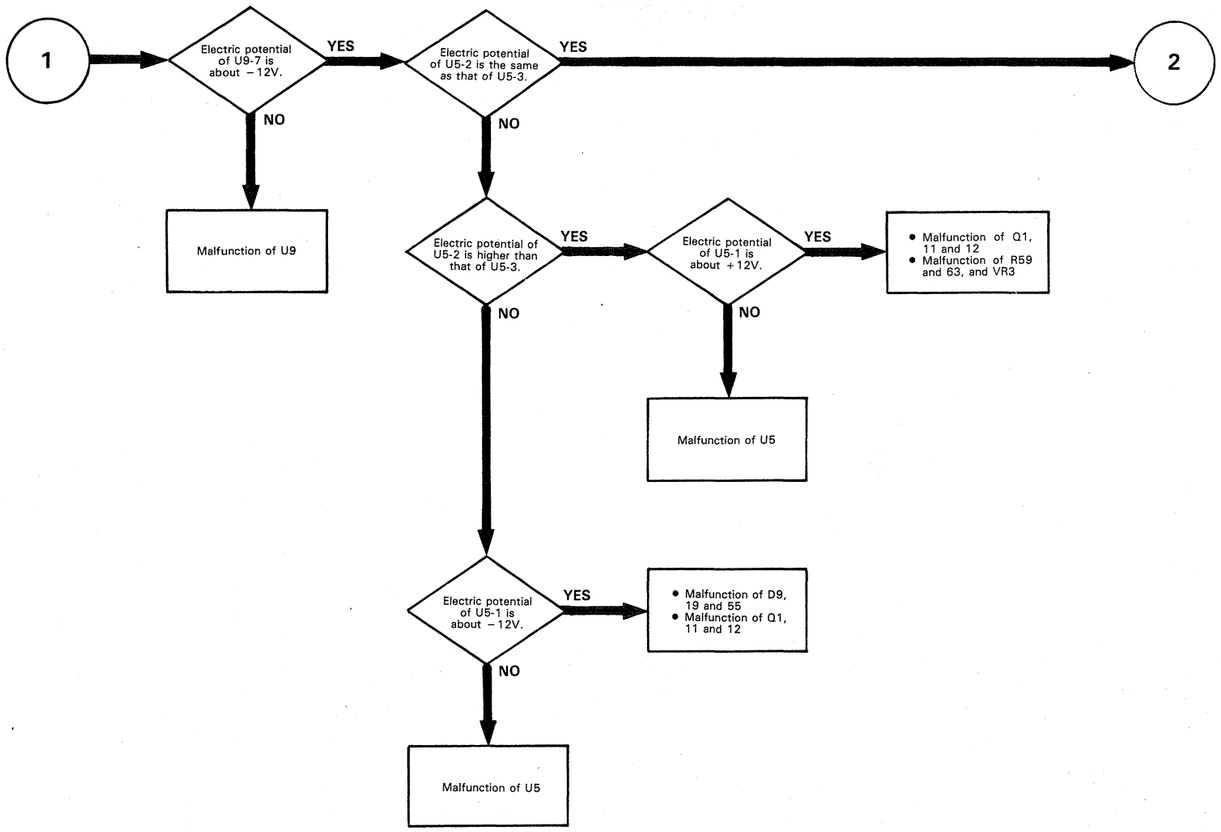

14
Electric potential of U20-14 is about − 1.2V.
YES
NO
Malfunction of R15 and 19
Electric potential of U20-3 and 13 are about +3.6V and −3.6V respectively. When U20-6, 10 and 9 are "L", "L" and "L" respectively.
YES
NO
Malfunction of U20
Electric potential of U20-3 and 13 are about +1.6V and −1.2V respectively, when U20-6, 10 and 9 is "L", "H" and "L" respectively.
YES
NO
U18-6 and 9 does not turn out to be "L" and "L".
YES
• Malfunction of U14
• Software is out of control.
NO
15
Electric potential of U10-1 is about +12V.
YES
Malfunction of Q4 and 17
NO
Malfunction of U10
When U18-6, 10 and 9 is at "L", "L" and "L" electric potential of U18-3 is the same that of U18-1.
YES
NO
When U18-6, 10 and 9 are "L", "H" and "L" respectively, the voltages at U18-3 and U18-5 are the same.
YES
NO
Malfunction of U18
Electric potential of U16-3 is the same as that of U16-1.
YES
NO
Malfunction of U16
17
16
• Malfunction of D25 and 60
• Malfunction of Q4 and 17
17
When U16-1 is about +3.5V or +1.6V, electric potential of U4-7 is input into U16-5.
YES
NO
Software is out of control.
When U16-1 is about −3.6V or −1.6V, electric potential of U4-1 is input into U16-5.
YES
NO
E
U16-1 functions as converter, and signal of +12V is output from U14-7.
YES
NO
Malfunction of U16
(PANEL UNIT)
Signals synchronized with U16-7 are sent to P103-6.
YES
NO
Malfunction of U105
U7-15 reminds staying at "H".
YES
NO
Ⓐof ① PANEL UNIT
END

TROUBLESHOOTING

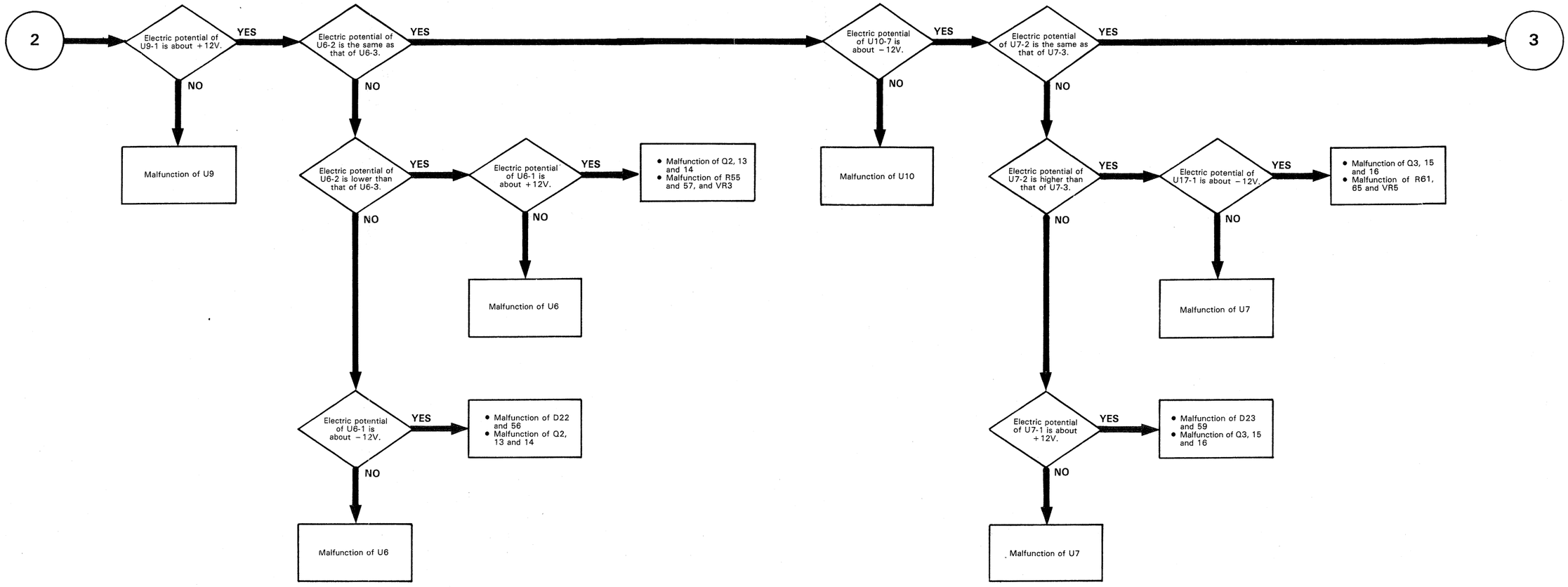

② AMP UNIT
Electric potential of U11-5, U12-5 and U1-2, U12-2 is about −7.1V and +7.1V respectively.
YES
NO
Malfunction of R56, 57 and 58
Electric potential of U11-6 is lower than that of U11-5.
YES
NO
• Impedance between terminals of +18 outputs which comes from emitter of Q11 and 12 is big. (Defective resistance or contact resistance is too big.)
Electric potential of U11-7 is about −12V.
YES
NO
Malfunction of U11
Electric potential of U11-3 is lower than that of U11-2.
YES
NO
• Impedance between terminals of −18 outputs which comes from emitter of Q13 and 14 is big. (Defective resistance or contact resistance is too big.)
Electric potential of U11-1 is about −12V.
YES
NO
Malfunction of U11
Electric potential of U12-6 is lower than that of U12-5.
YES
NO
• Impedance between terminals of +8 outputs which comes from emitter of Q15 and 16 is big. (Defective resistance or contact resistance is too big.)
Electric potential of U12-7 is about −12V.
YES
NO
Malfunction of U12
Electric potential of U12-3 is lower than that of U12-2.
YES
NO
• Impedance between terminals of −6 outputs which comes from emitter of Q17 is big. (Defective resistance or contact resistance is too big.)
1

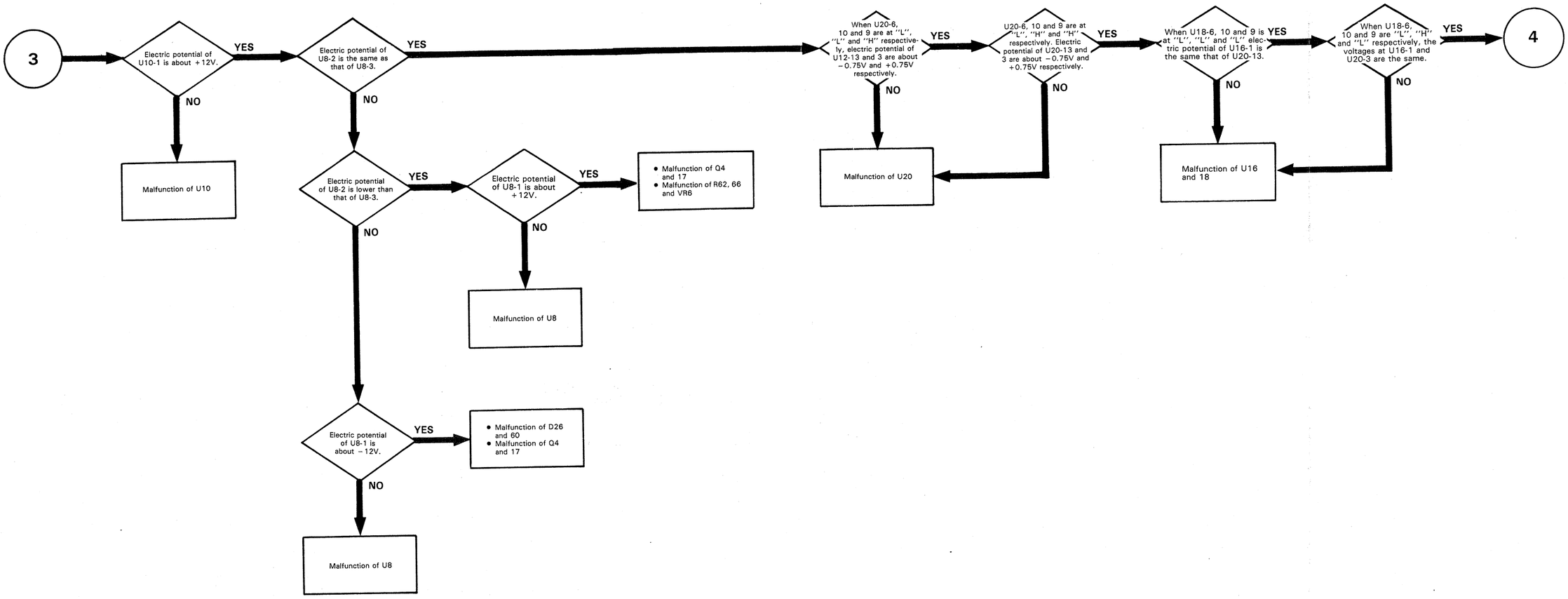



③ AMP UNIT
When the following operations are conducted, each voltage and current is set up, provided that rating had been set up.
Electric potential of U19-14 is about −0.75V.
YES
NO
Ⓐof AMP UNIT
Electric potential of U5-3 is about −0.75V.
YES
NO
Malfunction of R24 and C23
Electric potential of U19-12 is about +0.75V.
YES
NO
Ⓑof AMP UNIT
Electric potential of U6-3 is about +0.75V.
YES
NO
Malfunction of R26 and C25
Electric potential of U19-5 of is about −0.75V.
YES
NO
Ⓒof AMP UNIT
Electric potential of U7-3 is about −0.75V.
YES
NO
Malfunction of R28 and C27
Electric potential of U19-4 is about +0.75V.
YES
NO
Ⓓof AMP UNIT
Electric potential of U8-3 is about +0.75V.
YES
NO
Malfunction of R30 and C29
1

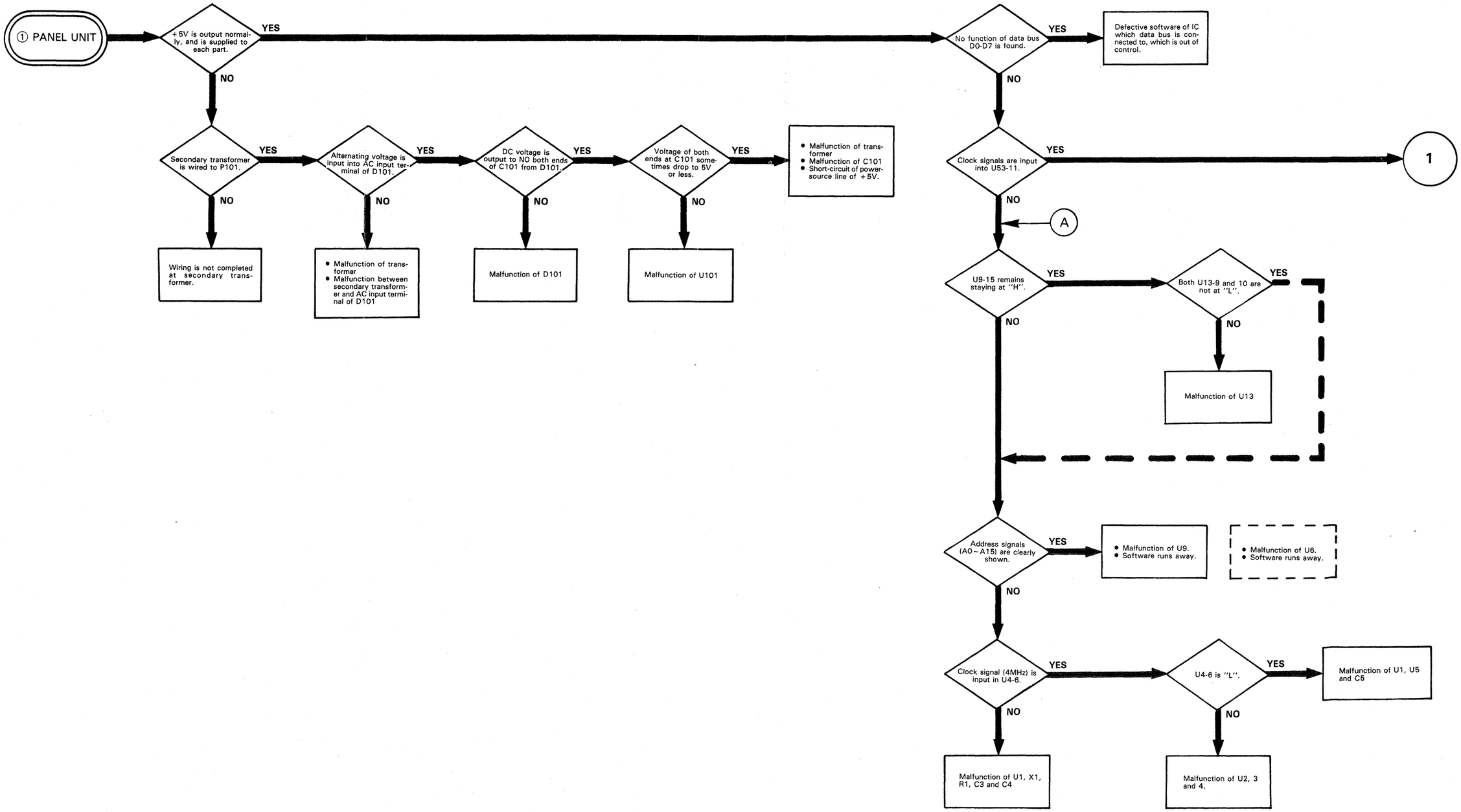

1
Electric potential of U9-7 is about −12V.
YES
NO
Malfunction of U9
Electric potential of U5-2 is the same as that of U5-3.
YES
NO
2
Electric potential of U5-2 is higher than that of U5-3.
YES
NO
Electric potential of U5-1 is about +12V.
YES
NO
• Malfunction of Q1, 11 and 12
• Malfunction of R59 and 63, and VR3
Malfunction of U5
Electric potential of U5-1 is about −12V.
YES
NO
• Malfunction of D9, 19 and 55
• Malfunction of Q1, 11 and 12
Malfunction of U5

TROUBLESHOOTING

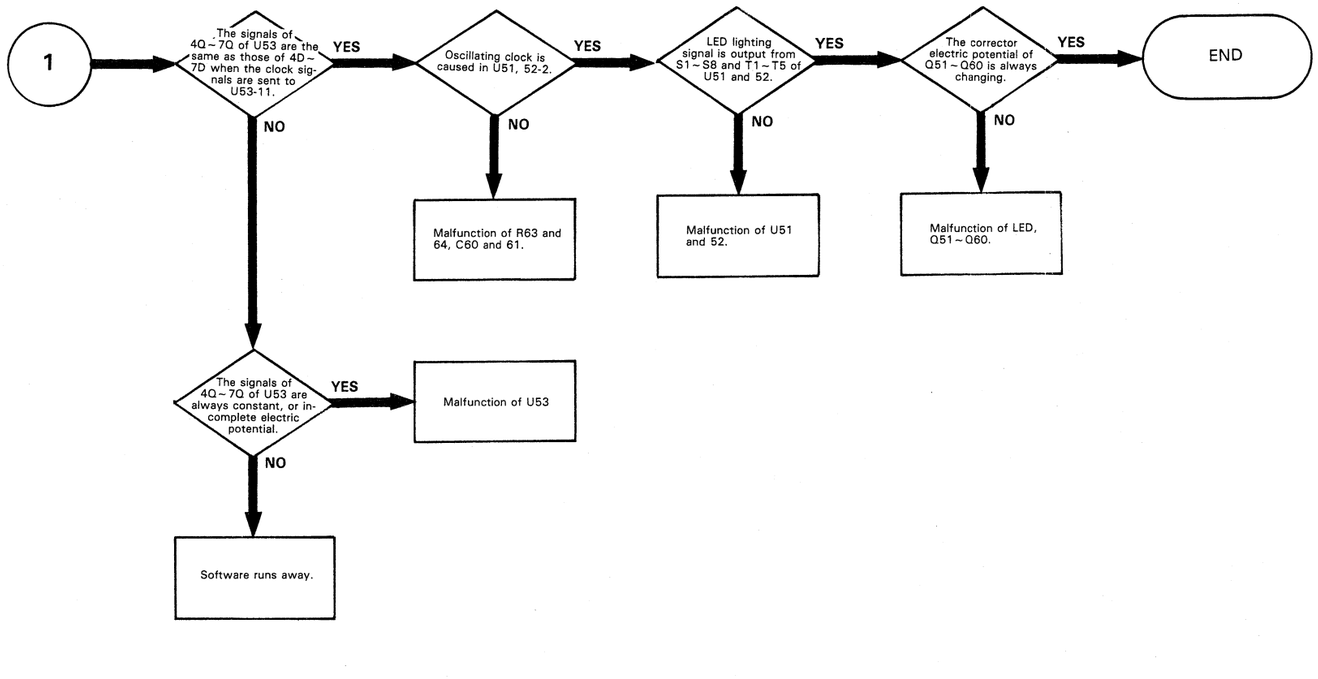



3
Electric potential of U10-1 is about +12V.
YES
NO
Malfunction of U10
Electric potential of U8-2 is the same as that of U8-3.
YES
NO
Electric potential of U8-2 is lower than that of U8-3.
YES
Electric potential of U8-1 is about +12V.
YES
• Malfunction of Q4 and 17
• Malfunction of R62, 66 and VR6
NO
Malfunction of U8
NO
Electric potential of U8-1 is about −12V.
YES
• Malfunction of D26 and 60
• Malfunction of Q4 and 17
NO
Malfunction of U8
When U20-6, 10 and 9 are at "L", "L" and "H" respectively, electric potential of U12-13 and 3 are about −0.75V and +0.75V respectively.
YES
NO
Malfunction of U20
U20-6, 10 and 9 are at "L", "H" and "H" respectively. Electric potential of U20-13 and 3 are about −0.75V and +0.75V respectively.
YES
NO
Malfunction of U20
When U18-6, 10 and 9 is at "L", "L" and "L" electric potential of U16-1 is the same that of U20-13.
YES
NO
Malfunction of U16 and 18
When U18-6, 10 and 9 are "L", "H" and "L" respectively, the voltages at U16-1 and U20-3 are the same.
YES
NO
Malfunction of U16 and 18
YES
4
4
When U16-1 is about +0.75V, electric potential of U4-1 is input into U16-5.
YES
NO
Software is out of control.
When U16-1 is about +0.75V, electric potential of U4-1 is input into U16-5.
YES
NO
Software is out of control.
©of AMP UNIT

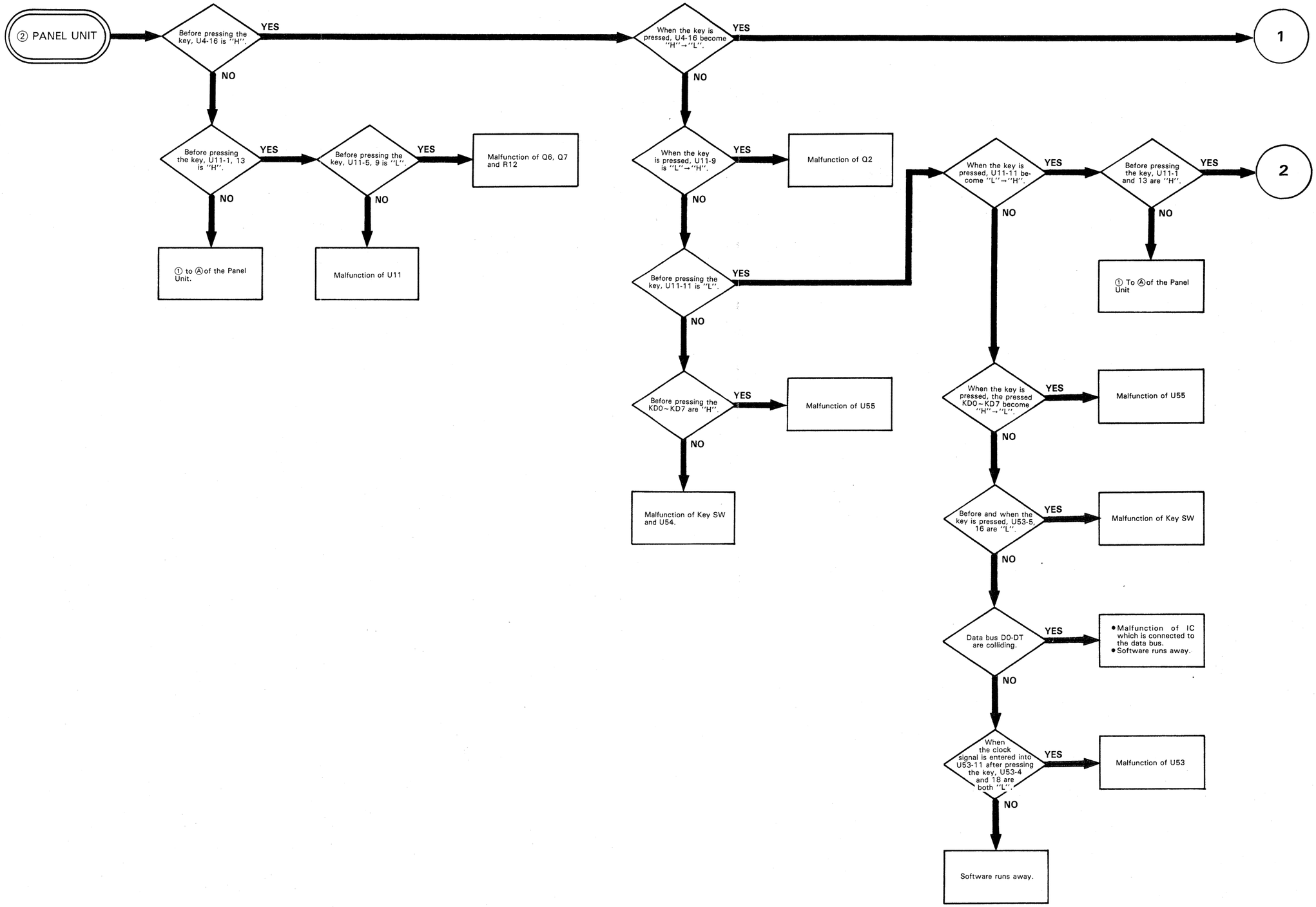
TROUBLESHOOTING


① PANEL UNIT
+5V is output normally, and is supplied to each part.
YES
NO
Secondary transformer is wired to P101.
YES
NO
Wiring is not completed at secondary transformer.
Alternating voltage is input into AC input terminal of D101.
YES
NO
• Malfunction of transformer
• Malfunction between secondary transformer and AC input terminal of D101
DC voltage is output to NO both ends of C101 from D101.
YES
NO
Malfunction of D101
Voltage of both ends at C101 sometimes drop to 5V or less.
YES
NO
Malfunction of U101
• Malfunction of transformer
• Malfunction of C101
• Short-circuit of power-source line of +5V.
No function of data bus D0-D7 is found.
YES
Defective software of IC which data bus is connected to, which is out of control.
NO
Clock signals are input into U53-11.
YES
1
NO
A
U9-15 remains staying at "H".
YES
Both U13-9 and 10 are not at "L".
YES
NO
Malfunction of U13
Address signals (A0~A15) are clearly shown.
YES
• Malfunction of U9.
• Software runs away.
• Malfunction of U6.
• Software runs away.
NO
Clock signal (4MHz) is input in U4-6.
YES
U4-6 is "L".
YES
Malfunction of U1, U5 and C5
NO
NO
Malfunction of U1, X1, R1, C3 and C4
Malfunction of U2, 3 and 4.

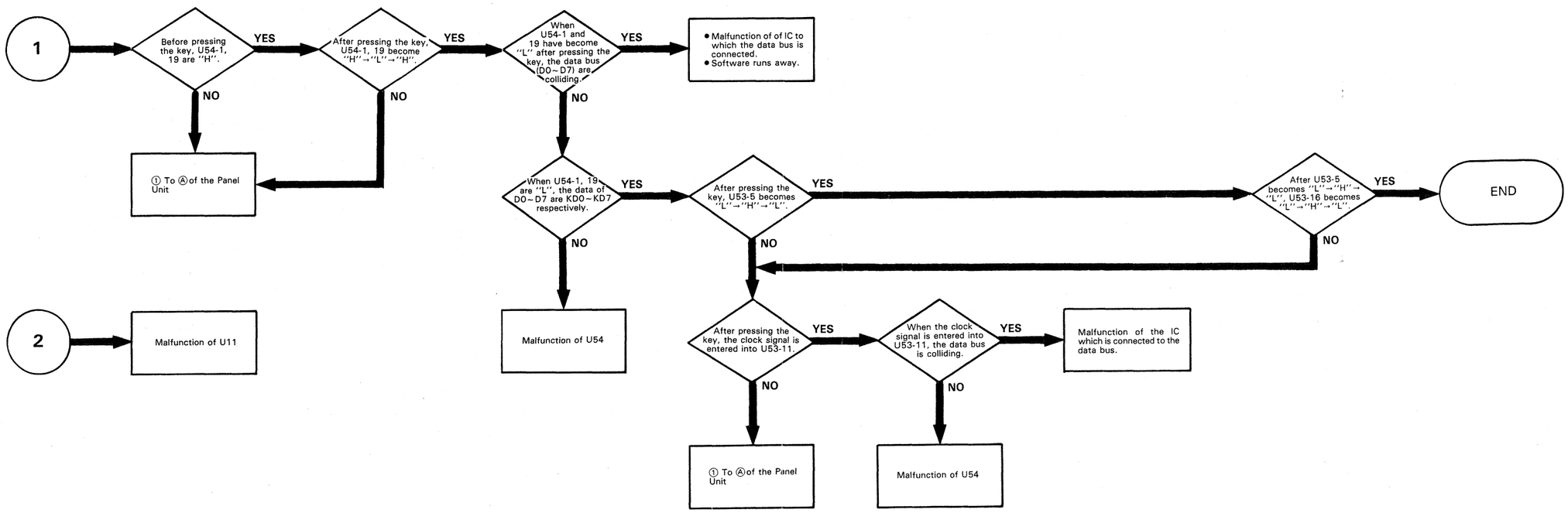
TROUBLESHOOTING

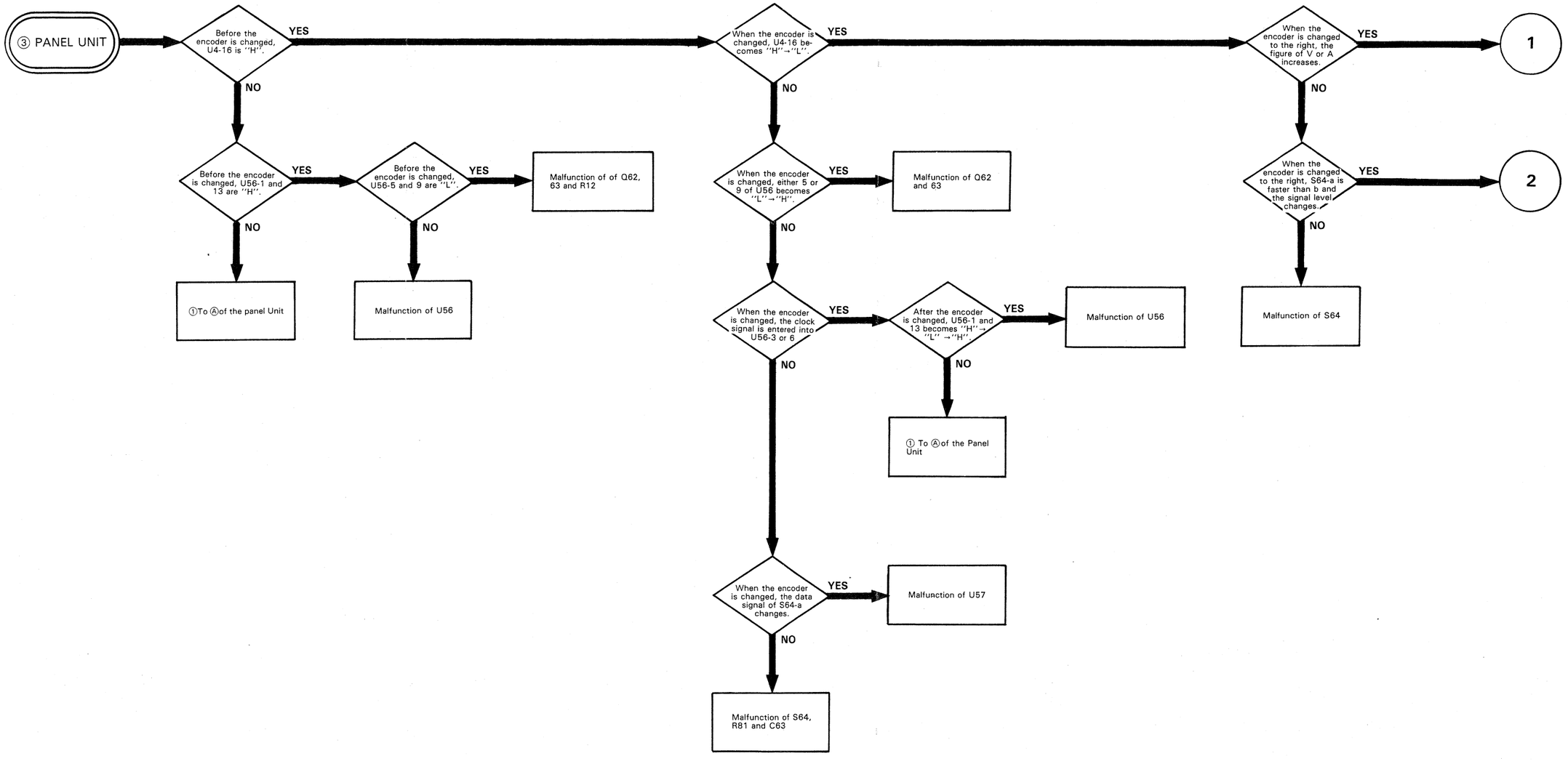

1
The signals of 4Q ~ 7Q of U53 are the same as those of 4D ~ 7D when the clock signals are sent to U53-11.
YES
NO
Oscillating clock is caused in U51, 52-2.
YES
NO
Malfunction of R63 and 64, C60 and 61.
LED lighting signal is output from S1 ~ S8 and T1 ~ T5 of U51 and 52.
YES
NO
Malfunction of U51 and 52.
The corrector electric potential of Q51 ~ Q60 is always changing.
YES
NO
Malfunction of LED, Q51 ~ Q60.
END
The signals of 4Q ~ 7Q of U53 are always constant, or incomplete electric potential.
YES
Malfunction of U53
NO
Software runs away.

TROUBLESHOOTING

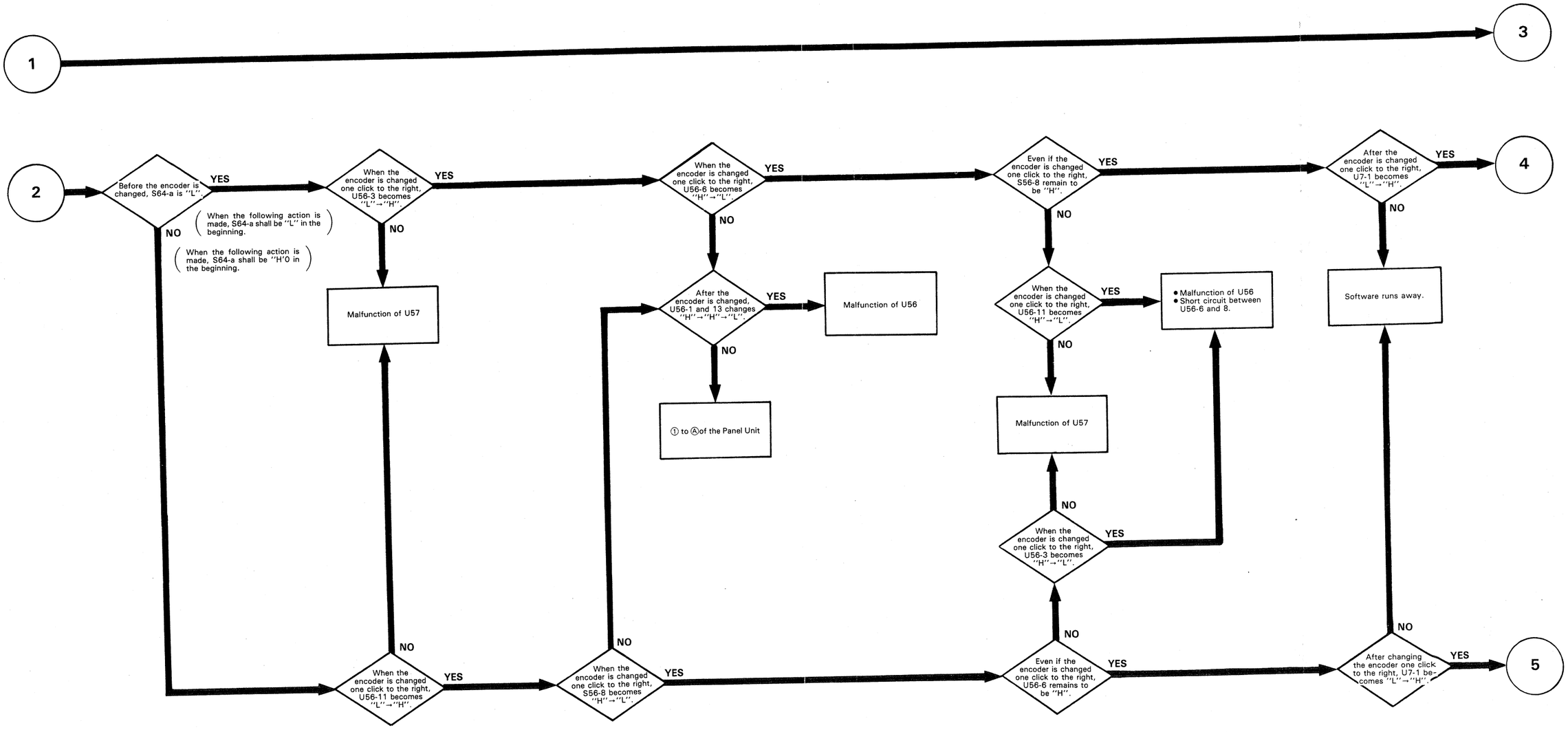


TROUBLESHOOTING

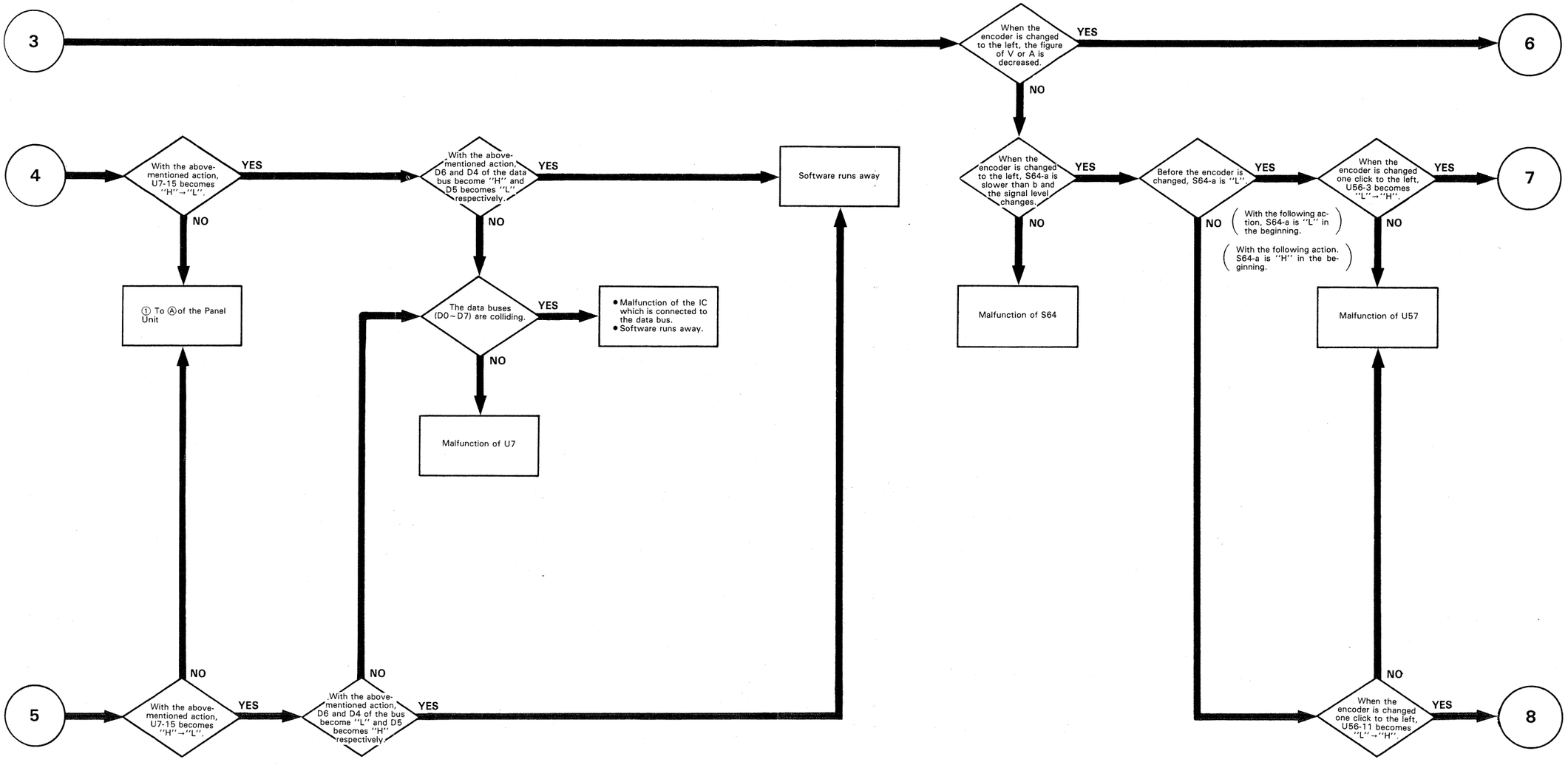

1
Before pressing the key, U54-1, 19 are "H".
YES
NO
After pressing the key, U54-1, 19 become "H"→"L"→"H".
YES
NO
When U54-1 and 19 have become "L" after pressing the key, the data bus (D0 – D7) are colliding.
YES
NO
• Malfunction of of IC to which the data bus is connected.
• Software runs away.
① To Ⓐof the Panel Unit
When U54-1, 19 are "L", the data of D0 – D7 are KD0 – KD7 respectively.
YES
NO
Malfunction of U54
After pressing the key, U53-5 becomes "L"→"H"→"L".
YES
NO
After U53-5 becomes "L"→"H"→"L", U53-16 becomes "L"→"H"→"L".
YES
NO
END
2
Malfunction of U11
After pressing the key, the clock signal is entered into U53-11.
YES
NO
When the clock signal is entered into U53-11, the data bus is colliding.
YES
NO
Malfunction of the IC which is connected to the data bus.
① To Ⓐof the Panel Unit
Malfunction of U54


③ PANEL UNIT
Before the encoder is changed, U4-16 is "H".
YES
NO
Before the encoder is changed, U56-1 and 13 are "H".
YES
NO
Before the encoder is changed, U56-5 and 9 are "L".
YES
NO
Malfunction of of Q62, 63 and R12
①To Ⓐof the panel Unit
Malfunction of U56
When the encoder is changed, U4-16 becomes "H"→"L".
YES
NO
When the encoder is changed, either 5 or 9 of U56 becomes "L"→"H".
YES
NO
Malfunction of Q62 and 63
When the encoder is changed, the clock signal is entered into U56-3 or 6
YES
NO
After the encoder is changed, U56-1 and 13 becomes "H"→"L" →"H".
YES
NO
Malfunction of U56
① To Ⓐof the Panel Unit
When the encoder is changed, the data signal of S64-a changes.
YES
NO
Malfunction of U57
Malfunction of S64, R81 and C63
When the encoder is changed to the right, the figure of V or A increases.
YES
NO
1
When the encoder is changed to the right, S64-a is faster than b and the signal level changes.
YES
NO
2
Malfunction of S64

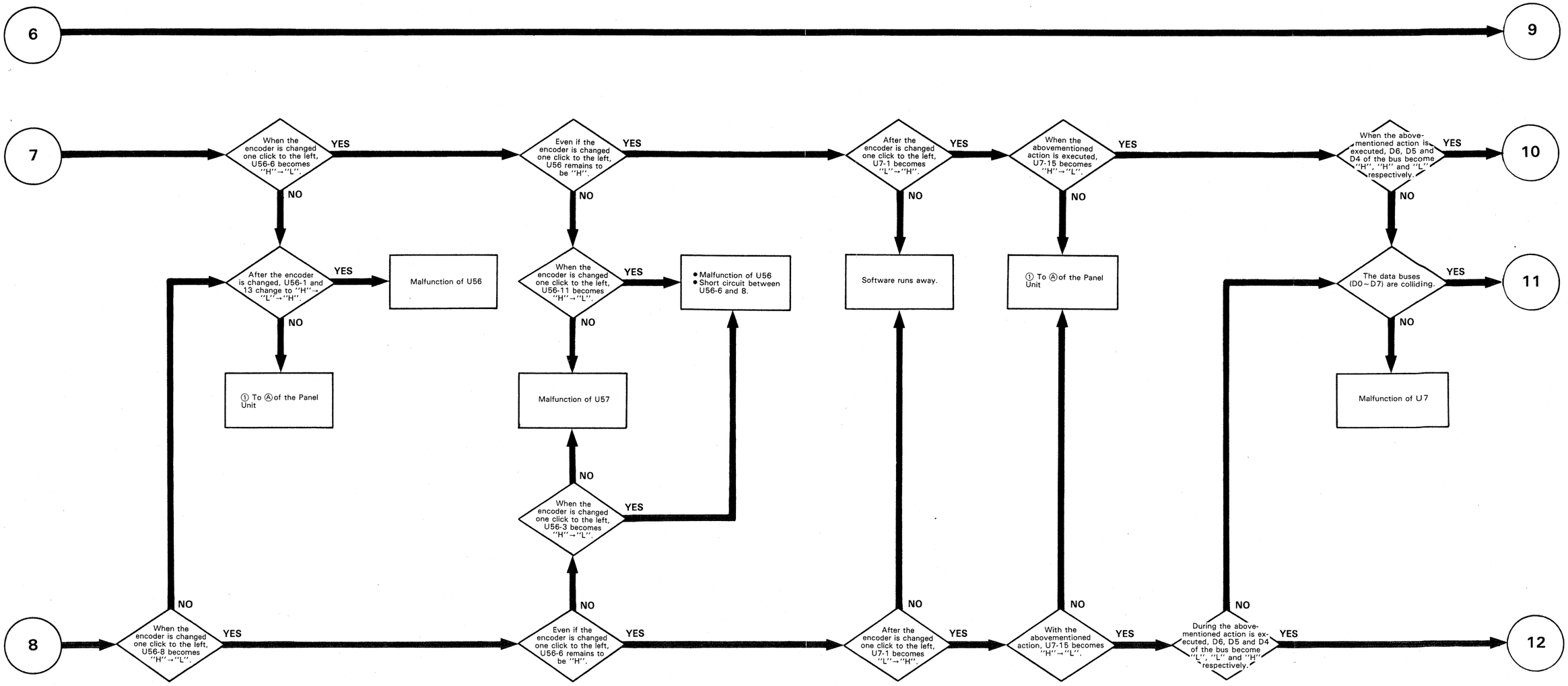
TROUBLESHOOTING

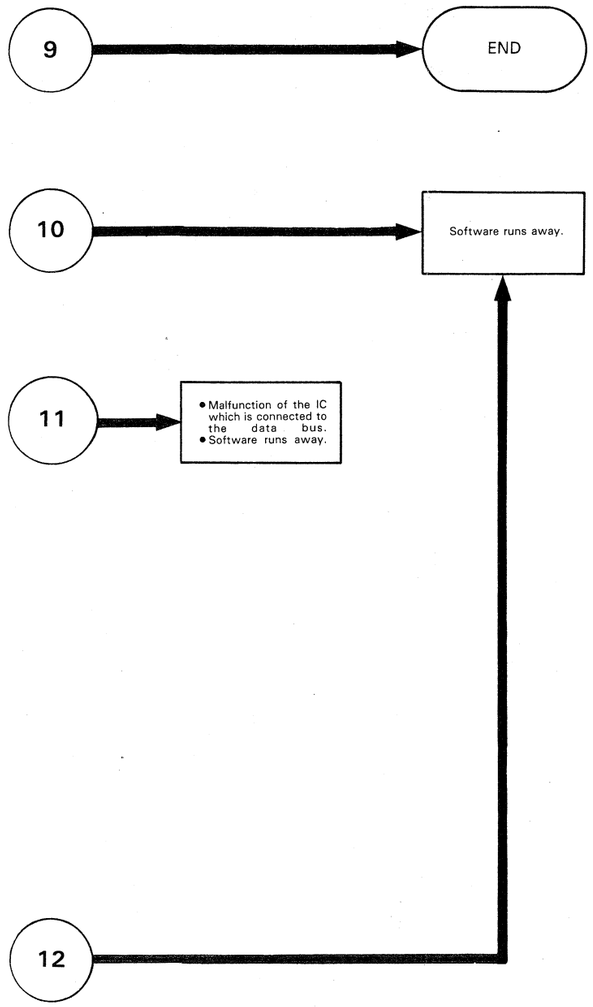

1
2
3
4
5
Before the encoder is changed, S64-a is "L".
YES
NO
(When the following action is made, S64-a shall be "L" in the beginning.)
(When the following action is made, S64-a shall be "H'0 in the beginning.)
When the encoder is changed one click to the right, U56-3 becomes "L"→"H".
YES
NO
Malfunction of U57
When the encoder is changed one click to the right, U56-11 becomes "L"→"H".
YES
NO
When the encoder is changed one click to the right, S56-8 becomes "H"→"L".
YES
NO
When the encoder is changed one click to the right, U56-6 becomes "H"→"L".
YES
NO
After the encoder is changed, U56-1 and 13 changes "H"→"H"→"L".
YES
NO
Malfunction of U56
① to Ⓐof the Panel Unit
Even if the encoder is changed one click to the right, S56-8 remain to be "H".
YES
NO
When the encoder is changed one click to the right, U56-11 becomes "H"→"L".
YES
NO
• Malfunction of U56
• Short circuit between U56-6 and 8.
When the encoder is changed one click to the right, U56-3 becomes "H"→"L".
YES
NO
Malfunction of U57
Even if the encoder is changed one click to the right, U56-6 remains to be "H".
YES
NO
After the encoder is changed one click to the right, U7-1 becomes "L"→"H".
YES
NO
Software runs away.
After changing the encoder one click to the right, U7-1 becomes "L"→"H".
YES
NO

TROUBLESHOOTING

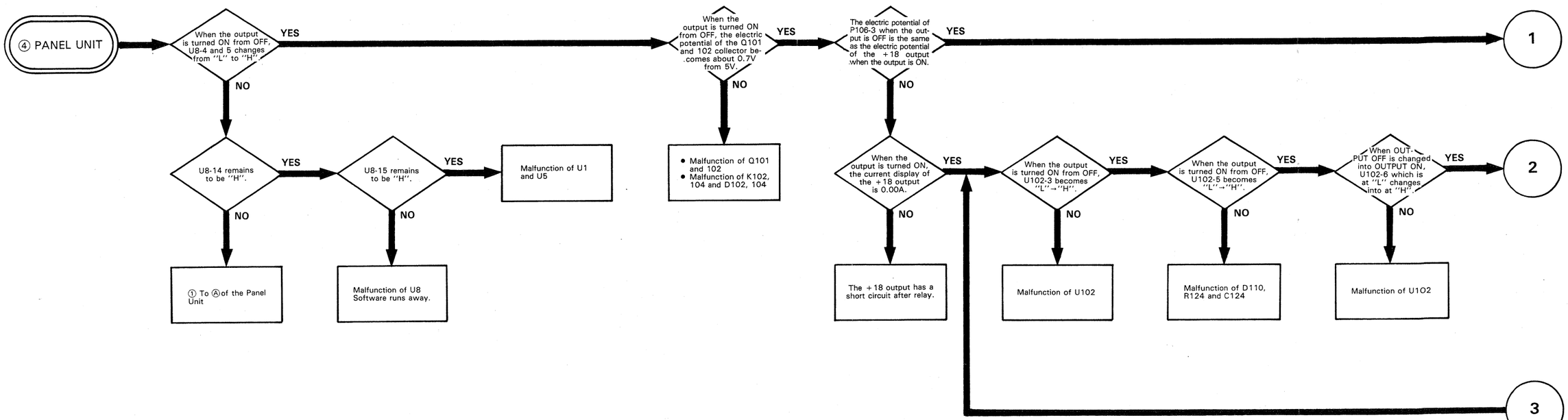

3
When the encoder is changed to the left, the figure of V or A is decreased.
YES
6
NO
4
With the above-mentioned action, U7-15 becomes "H"→"L".
YES
NO
With the above-mentioned action, D6 and D4 of the data bus become "H" and D5 becomes "L" respectively.
YES
NO
Software runs away
When the encoder is changed to the left, S64-a is slower than b and the signal level changes.
YES
NO
Before the encoder is changed, S64-a is "L".
YES
NO
(With the following action, S64-a is "L" in the beginning.)
(With the following action. S64-a is "H" in the beginning.)
When the encoder is changed one click to the left, U56-3 becomes "L"→"H".
YES
NO
7
① To Ⓐ of the Panel Unit
The data buses (D0 ~ D7) are colliding.
YES
NO
• Malfunction of the IC which is connected to the data bus.
• Software runs away.
Malfunction of U7
Malfunction of S64
Malfunction of U57
5
With the above-mentioned action, U7-15 becomes "H"→"L".
YES
NO
With the above-mentioned action, D6 and D4 of the bus become "L" and D5 becomes "H" respectively.
YES
NO
When the encoder is changed one click to the left, U56-11 becomes "L"→"H".
YES
8

TROUBLESHOOTING

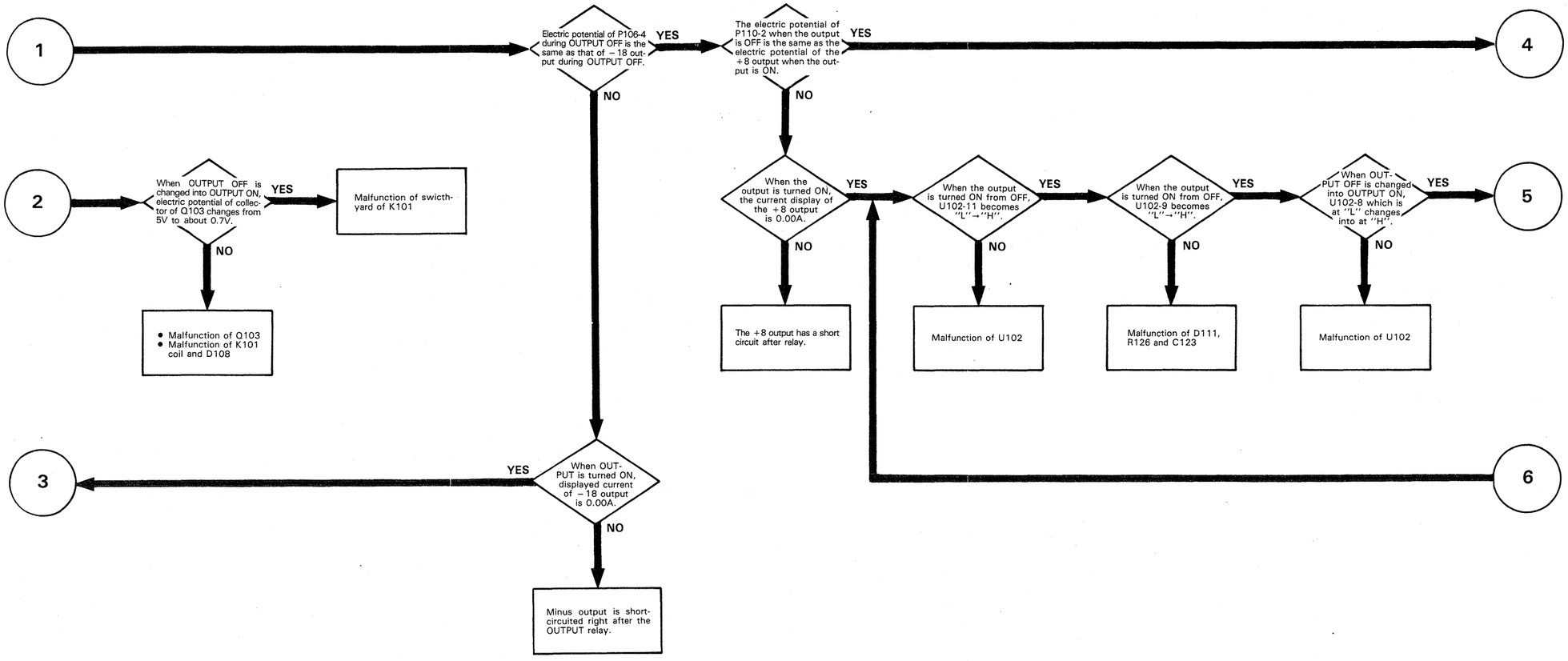

6
9
7
When the encoder is changed one click to the left, U56-6 becomes "H"→"L".
YES
NO
Even if the encoder is changed one click to the left, U56 remains to be "H".
YES
NO
After the encoder is changed one click to the left, U7-1 becomes "L"→"H".
YES
NO
When the abovementioned action is executed, U7-15 becomes "H"→"L".
YES
NO
When the above-mentioned action is executed, D6, D5 and D4 of the bus become "H", "H" and "L" respectively.
YES
NO
10
After the encoder is changed, U56-1 and 13 change to "H"→"L"→"H".
YES
NO
Malfunction of U56
When the encoder is changed one click to the left, U56-11 becomes "H"→"L".
YES
NO
● Malfunction of U56
● Short circuit between U56-6 and 8.
Software runs away.
① To Ⓐ of the Panel Unit
The data buses (D0 ~ D7) are colliding.
YES
NO
11
① To Ⓐ of the Panel Unit
Malfunction of U57
Malfunction of U7
NO
When the encoder is changed one click to the left, U56-3 becomes "H"→"L".
YES
8
When the encoder is changed one click to the left, U56-8 becomes "H"→"L".
YES
NO
Even if the encoder is changed one click to the left, U56-6 remains to be "H".
YES
NO
After the encoder is changed one click to the left, U7-1 becomes "L"→"H".
YES
NO
With the abovementioned action, U7-15 becomes "H"→"L".
YES
NO
During the above-mentioned action is executed, D6, D5 and D4 of the bus become "L", "L" and "H" respectively.
YES
NO
12

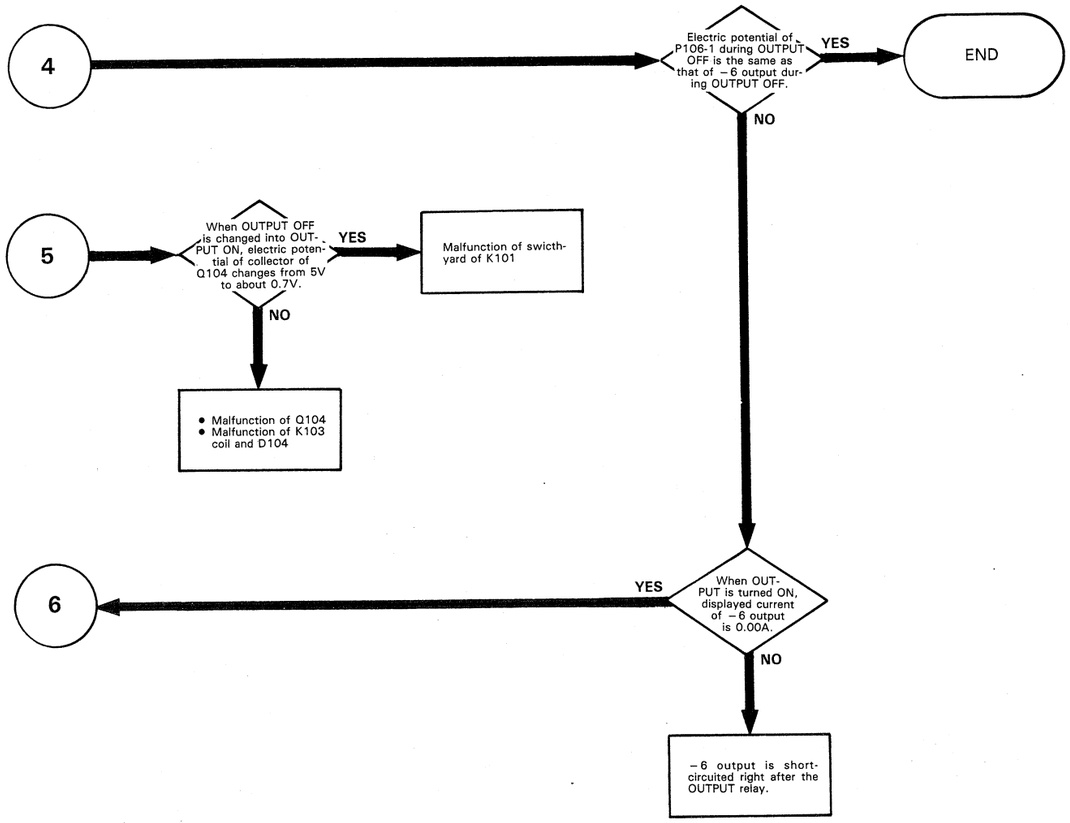

9
END
10
Software runs away.
11
• Malfunction of the IC which is connected to the data bus.
• Software runs away.
12

TROUBLESHOOTING

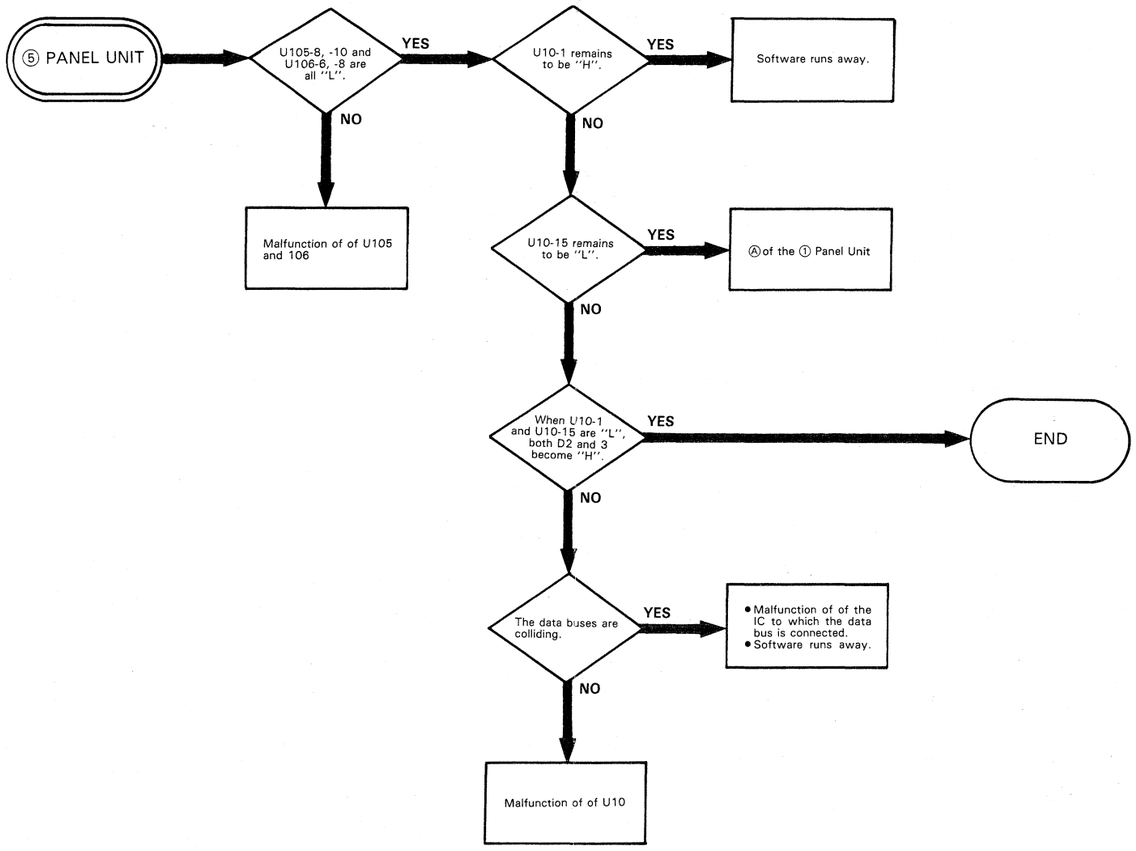

④ PANEL UNIT
When the output is turned ON from OFF, U8-4 and 5 changes from "L" to "H".
YES
NO
U8-14 remains to be "H".
YES
NO
U8-15 remains to be "H".
YES
NO
Malfunction of U1 and U5
① To Ⓐ of the Panel Unit
Malfunction of U8 Software runs away.
When the output is turned ON from OFF, the electric potential of the Q101 and 102 collector becomes about 0.7V from 5V.
YES
NO
• Malfunction of Q101 and 102
• Malfunction of K102, 104 and D102, 104
The electric potential of P106-3 when the output is OFF is the same as the electric potential of the +18 output when the output is ON.
YES
NO
When the output is turned ON, the current display of the +18 output is 0.00A.
YES
NO
The +18 output has a short circuit after relay.
When the output is turned ON from OFF, U102-3 becomes "L"→"H".
YES
NO
Malfunction of U102
When the output is turned ON from OFF, U102-5 becomes "L"→"H".
YES
NO
Malfunction of D110, R124 and C124
When OUTPUT OFF is changed into OUTPUT ON, U102-6 which is at "L" changes into at "H".
YES
NO
Malfunction of U102
1
2
3

TROUBLESHOOTING


1
Electric potential of P106-4 during OUTPUT OFF is the same as that of – 18 output during OUTPUT OFF.
YES
NO
The electric potential of P110-2 when the output is OFF is the same as the electric potential of the +8 output when the output is ON.
YES
NO
4
2
When OUTPUT OFF is changed into OUTPUT ON, electric potential of collector of Q103 changes from 5V to about 0.7V.
YES
NO
Malfunction of swicthyard of K101
• Malfunction of Q103
• Malfunction of K101 coil and D108
When the output is turned ON, the current display of the +8 output is 0.00A.
YES
NO
The +8 output has a short circuit after relay.
When the output is turned ON from OFF, U102-11 becomes "L"→"H".
YES
NO
Malfunction of U102
When the output is turned ON from OFF, U102-9 becomes "L"→"H".
YES
NO
Malfunction of D111, R126 and C123
When OUTPUT OFF is changed into OUTPUT ON, U102-8 which is at "L" changes into at "H".
YES
NO
Malfunction of U102
5
3
When OUTPUT is turned ON, displayed current of – 18 output is 0.00A.
YES
NO
Minus output is short-circuited right after the OUTPUT relay.
6


4
Electric potential of P106-1 during OUTPUT OFF is the same as that of −6 output during OUTPUT OFF.
YES
END
NO
5
When OUTPUT OFF is changed into OUTPUT ON, electric potential of collector of Q104 changes from 5V to about 0.7V.
YES
Malfunction of swicthyard of K101
NO
• Malfunction of Q104
• Malfunction of K103 coil and D104
6
YES
When OUTPUT is turned ON, displayed current of −6 output is 0.00A.
NO
−6 output is short-circuited right after the OUTPUT relay.

TROUBLESHOOTING

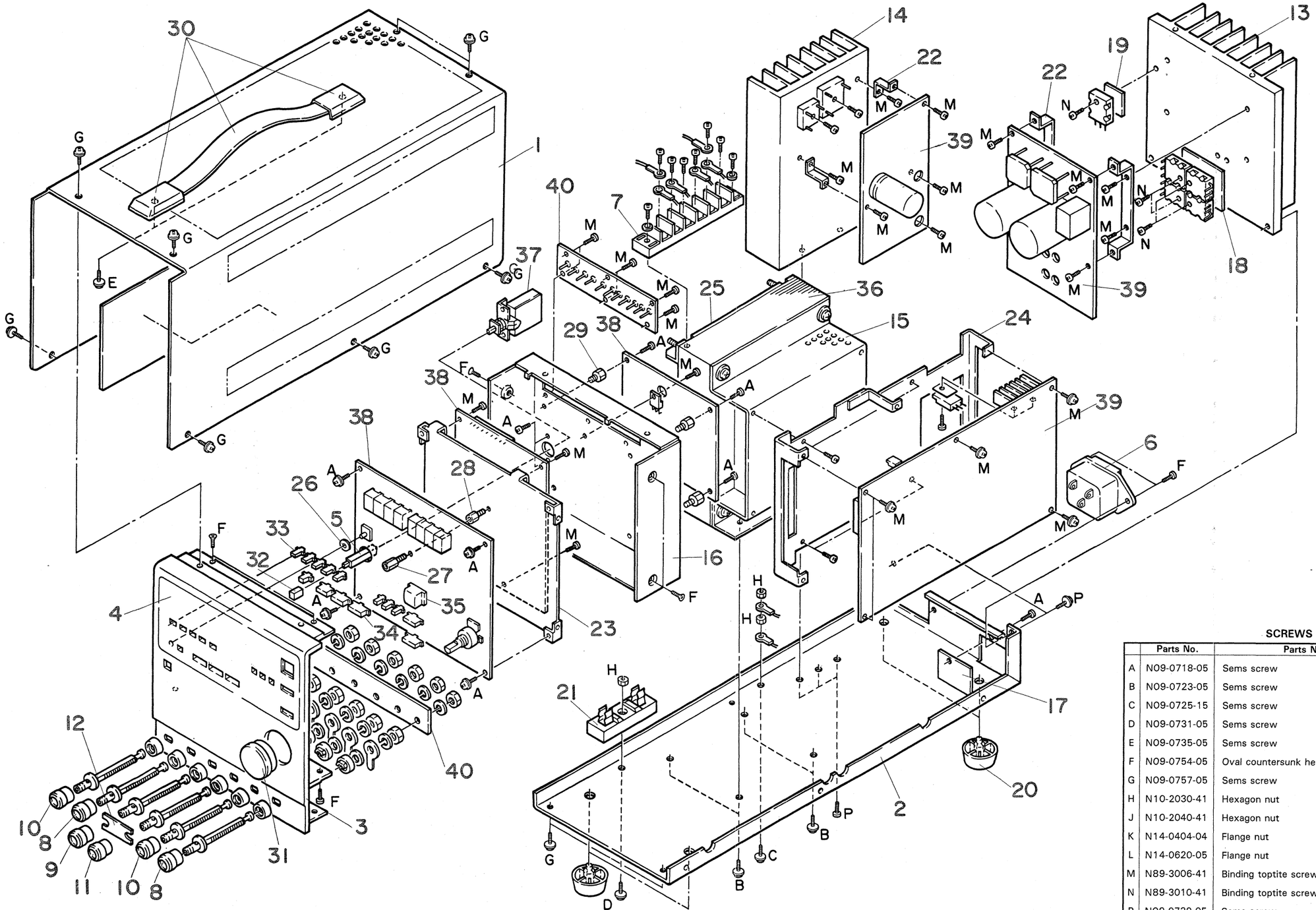


PARTS LIST

PW18-1.8Q UNIT
(Y86-1370-00)

REF.NO	PARTS NO	NAME & DESCRIPTION
	B40-2737-24	SERIAL NO. PLATE
	B41-0841-14	AC100V 50/60HZ 213W
	B41-0842-04	AC120V~ 50/60HZ 213W
	B41-0843-04	AC220V~ 50/60HZ 215W
	B41-0844-04	AC240V~ 50/60HZ 215W
	B41-0845-04	AC120V~ 60HZ 213W
	B41-0848-04	FUSE RATING LABEL
	B42-3700-04	CAUTION LABEL
	B50-7729-10	INSTRUCTION MANUAL,JAPANESE
	B50-7730-00	INSTRUCTION MANUAL,ENGLISH
	C90-0298-05	CAP. CERAMIC 0.1 20% 12V
	E30-1644-15	BS POWER CORD
	E30-1818-05	JIS POWER CORD
	E30-1819-05	CEE POWER CORD
	E30-1820-05	UL/CSA POWER CORD
	E30-1821-05	SAA POWER CORD
	E31-5811-15	WIRE ASS'Y:P102 TO PIERCED CAP
	E31-5812-15	WIRE ASS'Y; P1 TO TR
	E31-5813-15	WIRE ASS'Y:P51 TO PIERCED CAP.
	E31-5859-25	WIRE ASS'Y;AC PRIMARY
	E31-5860-05	WIRE ASS'Y; P106,110 TO P5 ETC
	E31-5861-05	WIRE ASS'Y;P103 TO PIERCED CAP
	E31-5862-05	WIRE ASS'Y;CHANGING VOLTAGE
	E31-5863-15	WIRE ASS'Y;WITH 10P HOUSING
	F51-0004-05	FUSE(SLOW BLOW) 3A/250V
	F51-0005-05	FUSE(SLOW BLOW) 1.5A/250V
	H01-5924-14	CARTON BOX
	H10-2846-02	FOAMED STYRENE PAD(FRONT)
	H10-2847-02	FOAMED STYRENE PAD(REAR)
	H20-1725-04	VINYL COVER
	J19-1620-05	CORD KEEP
	J61-0049-05	WIRE BAND
	NJM7805FA	IC,3-TERMINAL REGULATOR
	S10VB10	DIODE
	S4VB10	DIODE
	2SA1301(R)	TR. SI. PNP
	2SA1302(R)	TR. SI. PNP
	2SC3280(R)	TR. SI. NPN
	2SC3281(R)	TR. SI. NPN
1	A01-1226-02	CASE
2	A10-1460-12	CHASSIS
3	A20-2849-13	FRONT PANEL
4	B11-0517-03	FILTER
5	D21-0926-04	EXTENSION SHAFT
6	E18-0351-05	AC INLET 3 P
7	E20-5817-05	TERMINAL,FOR TRANSFORMER
8	E21-0670-03	TERMINAL,RED
9	E21-0671-03	TERMINAL,BLACK
10	E21-0672-03	TERMINAL,WHITE
11	E21-0673-03	TERMINAL,BULE
12	E29-0506-04	SHORTING BAR
13	F01-0877-03	HEAT SINK
14	F01-0878-03	HEAT SINK
15	F10-1626-03	SHIELD PLATE
16	F11-1240-03	SHIELD CASE
17	F15-0756-04	BLIND PLATE
18	F20-0689-05	INSULATOR
19	F20-0692-05	INSULATOR
20	J02-0323-05	LEG
21	J13-0038-05	FUSE HOLDER
22	J21-4678-04	BRACKET,FOR P.C.B
23	J21-4697-03	BRACKET
24	J21-4698-03	BRACKET
25	J21-4700-14	BRACKET
26	J30-0632-04	SPACER
27	J32-0122-04	BOSS
28	J32-0893-04	HEX. STUD
29	J32-0894-04	HEX. STUD
30	K01-0410-05	HANDLE
31	K21-0907-04	KNOB
32	K27-0509-04	PUSH BOTTON,ORANGE
33	K27-0555-04	BOTTON
34	K27-0556-04	BOTTON
35	K27-0557-04	BOTTON,RED
36	L01-9946-15	POWER TRANSFORMER
37	S40-2524-05	PUSH SWITCH (POWER)
38	X66-1110-00	PANEL UNIT
39	X73-1890-00	VERTICAL/HORIZONTAL UNIT
40	X81-2880-03	TERMINAL UNIT

DISASSEMPLY



SCREWS

	Parts No.	Parts Name		Figure
A	N09-0718-05	Sems screw	(M3×6)	
B	N09-0723-05	Sems screw	(M5×10)	
C	N09-0725-15	Sems screw	(M4×12)	
D	N09-0731-05	Sems screw	(M3×12)	
E	N09-0735-05	Sems screw	(M4×6)	
F	N09-0754-05	Oval countersunk head screw	(3×8)	
G	N09-0757-05	Sems screw	(3×6)	
H	N10-2030-41	Hexagon nut	(M3)	
J	N10-2040-41	Hexagon nut	(M4)	
K	N14-0404-04	Flange nut	(M3)	
L	N14-0620-05	Flange nut	(M4)	
M	N89-3006-41	Binding toptite screw	(3×6)	
N	N89-3010-41	Binding toptite screw	(3×10)	
P	N09-0739-05	Sems screw	(3×8)	

PARTS LIST

PANEL UNIT
(X66-1110-00)

REF.NO	PARTS NO	NAME & DESCRIPTION			
	B42-3703-04	LABEL,FOR ROM			
	E02-0143-05	SEMICONDUCTOR SOCKET 28P			
	E31-5841-05	WIRE ASS'Y: JW101 TO U1			
	E31-5842-05	WIRE ASS'Y: L3 TO J3			
	E31-5865-15	WIRE ASS'Y: P3 TO P104,105			
	E31-5870-05	WIRE ASS'Y: JW1 TO P52			
	E31-5872-05	WIRE ASS'Y: JW2 TO P52			
	F15-0744-05	BLIND PLATE			
	J25-5394-02	PCB (UNMOUNTED)			
	R92-1061-05	JUMPING RES. ZERO OHM (5MM)			
C001	CE04EW1A471M	CAP. ELECTRO	470	20%	10V
C002	CE04EW1A471M	CAP. ELECTRO	470	20%	10V
C003	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C004	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C005	CE04EW1H2R2M	CAP. ELECTRO	2.2	20%	50V
C006	CF92V1H473J	CAP. POLYESTER	0.047	5%	50V
C007	C91-1310-05	CAP. DOUBLE 0.1F -20/+80%			5.5V
C008	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C009	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C010	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C011	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C012	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C013	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C014	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C015	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C016	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C017	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C018	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C019	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C051	CE04EW1A221M	CAP. ELECTRO	220	20%	10V
C052	CE04EW1A221M	CAP. ELECTRO	220	20%	10V
C053	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C054	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C055	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C056	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C057	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C058	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C059	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C060	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C061	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C062	CK45B1H103K	CAP. CERAMIC	0.01	10%	50V
C101	C90-3008-05	CAP. CERAMIC	3900	20%	16V
C102	CE04EW1A471M	CAP. ELECTRO	470	20%	10V
C103	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C104	CE04EW1A101M	CAP. ELECTRO	100	20%	10V
C105	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C106	CE04EW1A101M	CAP. ELECTRO	100	20%	10V
C107	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C108	CF92V1H153J	CAP. POLYESTER	0.015	5%	50V
C123	CF92V1H104J	CAP. POLYESTER	0.1	5%	50V
C124	CF92V1H104J	CAP. POLYESTER	0.1	5%	50V
C125	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C126	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
D001	1S1587	DIODE			
D002	1S1587	DIODE			
D003	1SS132	DIODE			
D051	GL-8D03D	LED,RED;7 SEGMENT			
D052	GL-8D03D	LED,RED;7 SEGMENT			
D053	GL-8D03D	LED,RED;7 SEGMENT			
D054	GL-8D03D	LED,RED;7 SEGMENT			
D055	GL-8D03D	LED,RED;7 SEGMENT			
D056	GL-8D03D	LED,RED;7 SEGMENT			
D057	GL-8D03D	LED,RED;7 SEGMENT			
D058	GL-8D03D	LED,RED;7 SEGMENT			
D059	B30-0972-05	LED,RED			
D060	B30-0973-05	LED,GREEN			
D061	B30-0972-05	LED,RED			
D062	B30-0973-05	LED,GREEN			
D063	B30-0973-05	LED,GREEN			
D064	B30-0973-05	LED,GREEN			
D065	B30-0972-05	LED,RED			
D066	B30-0972-05	LED,RED			
D067	B30-0972-05	LED,RED			
D068	B30-0973-05	LED,GREEN			
D069	B30-0973-05	LED,GREEN			

REF.NO	PARTS NO	NAME & DESCRIPTION			
D070	B30-0973-05	LED,GREEN			
D071	B30-0973-05	LED,GREEN			
D072	B30-0973-05	LED,GREEN			
D073	B30-0973-05	LED,GREEN			
D074	B30-0973-05	LED,GREEN			
D101	S1VB10	DIODE			
D102	1SS132	DIODE			
D103	1SS132	DIODE			
D104	S3V10	DIODE			
D105	S3V10	DIODE			
D106	S3V10	DIODE			
D107	S3V10	DIODE			
D108	1SS132	DIODE			
D109	1SS132	DIODE			
D110	1SS132	DIODE			
D111	1SS132	DIODE			
K101	SS1-2508-05	RELAY			
K102	SS1-2511-05	RELAY			
K103	SS1-2508-05	RELAY			
K104	SS1-2511-05	RELAY			
L001	L40-4701-03	FERRI INDUCTOR	47UH	10%	
L051	L40-4701-03	FERRI INDUCTOR	47UH	10%	
P001	E40-3237-05	PIN CONNECTOR	2P		
P004	E40-5067-05	PIN CONNECTOR	10P		
P051	E40-3237-05	PIN CONNECTOR	2P		
P101	E40-3237-05	PIN CONNECTOR	2P		
P102	E40-3239-05	PIN CONNECTOR	4P		
P103	E40-5067-05	PIN CONNECTOR	10P		
P104	E40-5067-05	PIN CONNECTOR	10P		
P105	E40-3237-05	PIN CONNECTOR	2P		
P106	E40-3239-05	PIN CONNECTOR	4P		
P107	NO USE				
P108	E40-4248-05	PIN CONNECTOR	2P		
P109	E40-3911-05	PIN CONNECTOR	3P		
P110	E40-3239-05	PIN CONNECTOR	4P		
P111	NO USE				
P112	E40-4248-05	PIN CONNECTOR	2P		
P113	E40-4248-05	PIN CONNECTOR	2P		
Q001	2SC2785(F)	TR. SI. NPN			
Q002	2SC2785(F)	TR. SI. NPN			
Q051	2SC2785(F)	TR. SI. NPN			
Q052	2SC2785(F)	TR. SI. NPN			
Q053	2SC2785(F)	TR. SI. NPN			
Q054	2SC2785(F)	TR. SI. NPN			
Q055	2SC2785(F)	TR. SI. NPN			
Q056	2SC2785(F)	TR. SI. NPN			
Q057	2SC2785(F)	TR. SI. NPN			
Q058	2SC2785(F)	TR. SI. NPN			
Q059	2SC2785(F)	TR. SI. NPN			
Q060	2SC2785(F)	TR. SI. NPN			
Q061	NO USE				
Q062	2SC2785(F)	TR. SI. NPN			
Q063	2SC2785(F)	TR. SI. NPN			
Q101	2SC1815(Y)	TR. SI. NPN			
Q102	2SC1815(Y)	TR. SI. NPN			
Q103	2SC1815(Y)	TR. SI. NPN			
Q104	2SC1815(Y)	TR. SI. NPN			
R001	RD14BB2C105J	RES. CARBON	1M	5%	1/6W
R002	NO USE				
R003	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R004	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R005	RD14BB2C273J	RES. CARBON	27K	5%	1/6W
R006	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R007	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R008	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R011	R90-0612-05	RES. NETWORK	4.7K X 8		
R012	R90-0612-05	RES. NETWORK	4.7K X 8		
R051	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R052	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W

PARTS LIST

REF.NO	PARTS NO	NAME & DESCRIPTION			
R053	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R054	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R055	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R056	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R057	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R058	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R059	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R060	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R061	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R062	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R063	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R064	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R065	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R066	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R067	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R068	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R069	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R070	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R071	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R072	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R073	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R074	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R075	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R076	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R079	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R080	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R081	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R082	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
R083	RD14BB2C104J	RES. CARBON	100K	5%	1/6W
R084	RD14BB2C104J	RES. CARBON	100K	5%	1/6W
R085	R90-0612-05	RES. NETWORK	4.7K X 8		
R101	RD14BB2C361J	RES. CARBON	360	5%	1/6W
R102	RD14BB2C361J	RES. CARBON	360	5%	1/6W
R103	RD14BB2C361J	RES. CARBON	360	5%	1/6W
R104	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R105	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R106	RD14BB2C431J	RES. CARBON	430	5%	1/6W
R107	RD14BB2C431J	RES. CARBON	430	5%	1/6W
R108	RD14BB2C431J	RES. CARBON	430	5%	1/6W
R109	RD14BB2C431J	RES. CARBON	430	5%	1/6W
R110	RD14BB2C431J	RES. CARBON	430	5%	1/6W
R111	RD14BB2C431J	RES. CARBON	430	5%	1/6W
R112	RD14BB2C431J	RES. CARBON	430	5%	1/6W
R113	RD14BB2C431J	RES. CARBON	430	5%	1/6W
R120	E31-2170-05	JUMPING WIRE			
R121	E31-2170-05	JUMPING WIRE			
R122	RD14BB2E220J	RES. CARBON	22	5%	1/4W
R123	RD14BB2E220J	RES. CARBON	22	5%	1/4W
R124	RD14BB2C154J	RES. CARBON	150K	5%	1/6W
R125	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R126	RD14BB2C154J	RES. CARBON	150K	5%	1/6W
R127	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R128	NO USE				
R129	RD14BB2E220J	RES. CARBON	22	5%	1/4W
R130	RD14BB2E220J	RES. CARBON	22	5%	1/4W
R131	E31-2170-05	JUMPING WIRE			
R136	RD14BB2C751J	RES. CARBON	750	5%	1/6W
S051	S50-1426-05	TACT SWITCH			
S052	S50-1426-05	TACT SWITCH			
S053	S50-1426-05	TACT SWITCH			
S054	S50-1426-05	TACT SWITCH			
S055	S50-1426-05	TACT SWITCH			
S056	S50-1426-05	TACT SWITCH			
S057	S50-1426-05	TACT SWITCH			
S058	S50-0503-05	TACT SWITCH			
S059	S50-1426-05	TACT SWITCH			
S060	S50-1426-05	TACT SWITCH			
S061	S50-1426-05	TACT SWITCH			
S062	S50-1426-05	TACT SWITCH			
S063	S50-1426-05	TACT SWITCH			
S064	W02-0388-05	ROTARY ENCORDER			
S065	S50-1426-05	TACT SWITCH			
S066	S50-1426-05	TACT SWITCH			
S067	S50-1426-05	TACT SWITCH			
U001	TC74HCU04AP	IC,HEX INVERTER			
U002	T93-0693-04	IC,PROGRAM ROM			
U003	HM6264ALP-15L	IC,C-MOS STATIC RAM			
U004	LH0080A	IC,CPU			

REF.NO	PARTS NO	NAME & DESCRIPTION
U005	MB3773P-G	IC,RESET
U006	TC74HC139AP	IC,DUAL 2 TO 4 DEMULTIPLEXERS
U007	TC74HC257AP	IC,QUAD 2-DATA SELECT./MPX(3-S
U008	TC74HC259AP	IC,8-BIT ADDRESSABLE LATCHES
U009	TC74HC139AP	IC,DUAL 2 TO 4 DEMULTIPLEXERS
U010	TC74HC257AP	IC,QUAD 2-DATA SELECT./MPX(3-S
U011	TC74HC74AP	IC,DUAL D-FFS
U012	NJM555D	IC,TIMER
U013	TC74HC32AP	IC,QUAD 2 INPUT OR
U051	TC9191P	IC,DRIVER
U052	TC74HC541AP	IC,OCTAL 3-STATE BUFFER
U053	TC74HC374AP	IC,OCTAL 3-STATE D-FFS
U054	TC9191P	IC,DRIVER
U055	TC74HC30AP	IC,8 INPUT NAND
U056	TC74HC74AP	IC,DUAL D-FFS
U057	TC74HC14AP	IC,HEX SCHMITT TRIGGER INVERT.
U102	TC74HC125AP	IC,QUAD 3 STATE BUS BUFFERS
U103	PC837	IC,PHOTO COUPLER
U104	NO USE	
U105	PC837	IC,PHOTO COUPLER
U106	PC827	IC,PHOTO COUPLER
X001	L78-0104-05	RESONATOR

AMP UNIT
(X73-1890-00)

REF.NO	PARTS NO	NAME & DESCRIPTION			
	E23-0401-05	PIN TERMINAL			
	E38-0024-15	WIRE ASS'Y:JW3 TO 2SC3280			
	E38-0108-05	WIRE ASS'Y:P14 TO JW2.ETC.			
	F02-0520-05	HEAT SINK			
	J25-5395-22	PCB (UNMOUNTED)			
	N09-0626-04	SCREW,SEMS	M3X10		
C001	C90-3009-05	CAP. ELECTRO	2700	20%	25V
C002	C90-3009-05	CAP. ELECTRO	2700	20%	25V
C003	CE04EW1C331M	CAP. ELECTRO	330	20%	16V
C004	CE04EW1C221M	CAP. ELECTRO	220	20%	16V
C005	CE04EW1H2R2M	CAP. ELECTRO	2.2	20%	50V
C006	CE04EW1H2R2M	CAP. ELECTRO	2.2	20%	50V
C007	CE04EW1H2R2M	CAP. ELECTRO	2.2	20%	50V
C008	CE04EW1H2R2M	CAP. ELECTRO	2.2	20%	50V
C009	CE04EW1A101M	CAP. ELECTRO	100	20%	10V
C010	CE04EW1A101M	CAP. ELECTRO	100	20%	10V
C011	CE04EW1C100M	CAP. ELECTRO	10	20%	16V
C012	CE04EW1C100M	CAP. ELECTRO	10	20%	16V
C013	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C014	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C015	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C016	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C017	NO USE				
C018	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C019	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C020	C90-0298-05	CAP. CERAMIC	0.1	20%	12V
C021	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C022	CF92V1H105J	CAP. POLYESTER	1	5%	50V
C023	CF92V1H474J	CAP. POLYESTER	0.47	5%	50V
C024	CF92V1H105J	CAP. POLYESTER	1	5%	50V
C025	CF92V1H474J	CAP. POLYESTER	0.47	5%	50V
C026	CF92V1H105J	CAP. POLYESTER	1	5%	50V
C027	CF92V1H474J	CAP. POLYESTER	0.47	5%	50V
C028	CF92V1H105J	CAP. POLYESTER	1	5%	50V
C029	CF92V1H474J	CAP. POLYESTER	0.47	5%	50V
C038	CE04EW1C100M	CAP. ELECTRO	10	20%	16V
C039	CE04EW1C100M	CAP. ELECTRO	10	20%	16V
C040	CF92V1H474J	CAP. POLYESTER	0.47	5%	50V
C041	CF92V1H474J	CAP. POLYESTER	0.47	5%	50V
C044	CE04EW1C100M	CAP. ELECTRO	10	20%	16V
C045	CE04EW1C100M	CAP. ELECTRO	10	20%	16V
C046	CE04EW1C100M	CAP. ELECTRO	10	20%	16V
C047	CE04EW1C100M	CAP. ELECTRO	10	20%	16V
C048	CE04EW1C100M	CAP. ELECTRO	10	20%	16V
C049	CE04EW1C100M	CAP. ELECTRO	10	20%	16V
C050	NO USE				
C051	C90-3017-05	CAP. ELECTRO	6800	20%	50V
C052	C90-3017-05	CAP. ELECTRO	6800	20%	50V
C053	C90-0973-05	CAP. ELECTRO	6800	20%	25V
C054	C90-0986-05	CAP. ELECTRO	3300	20%	25V

PARTS LIST

REF.NO	PARTS NO	NAME & DESCRIPTION			
C065	CE04EW1E470M	CAP. ELECTRO	47	20%	25V
C066	CE04EW1E470M	CAP. ELECTRO	47	20%	25V
C067	CE04EW1E470M	CAP. ELECTRO	47	20%	25V
C068	CE04EW1E470M	CAP. ELECTRO	47	20%	25V
C069	CF93AN2E104K	CAP. METAL FILM	0.1	10%	250V
C070	CF93AN2E104K	CAP. METAL FILM	0.1	10%	250V
C071	CF93AN2E104K	CAP. METAL FILM	0.1	10%	250V
C072	CF93AN2E104K	CAP. METAL FILM	0.1	10%	250V
C073	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C074	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C075	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C076	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C077	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C078	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C079	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C080	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
C081	CK45FF1H103Z	CAP. CERAMIC	0.01		50V
D001	S1VB10	DIODE			
D002	MTZ9.1JC	DIODE, ZENER	9.6V		
D003	1SZ59	DIODE, ZENER	6.5V		
D004	MTZ5.1JA	DIODE, ZENER	4.94V		
D005	1SS132	DIODE			
D006	1SS132	DIODE			
D007	1SS132	DIODE			
D008	1SS132	DIODE			
D009	1SS132	DIODE			
D010	1SS132	DIODE			
D011	1SS132	DIODE			
D012	1SS132	DIODE			
D013	1SS132	DIODE			
D014	1SS132	DIODE			
D015	1SS132	DIODE			
D016	1SS132	DIODE			
D017	1SS132	DIODE			
D018	NO USE				
D019	1SS132	DIODE			
D020	1SS132	DIODE			
D021	1SS132	DIODE			
D022	1SS132	DIODE			
D023	1SS132	DIODE			
D024	1SS132	DIODE			
D025	1SS132	DIODE			
D026	1SS132	DIODE			
D027	1SS132	DIODE			
D028	1SS132	DIODE			
D051	S10VB10F1	DIODE			
D052	S10VB10F1	DIODE			
D053	1SS132	DIODE			
D054	1SS132	DIODE			
D055	DSA1A2	DIODE			
D056	DSA1A2	DIODE			
D059	DSA1A2	DIODE			
D060	DSA1A2	DIODE			
K001	S51-1528-05	RELAY			
K002	S51-1528-05	RELAY			
L001	L40-4701-03	FERRI INDUCTOR	47UH	10%	
P001	E40-3238-05	PIN CONNECTOR	3P		
P002	NO USE				
P003	E40-5069-05	PIN CONNECTOR	12P		
P004	NO USE				
P005	E40-3239-05	PIN CONNECTOR	4P		
P011	E40-3911-05	PIN CONNECTOR	3P		
P012	E40-3911-05	PIN CONNECTOR	3P		
P013	E40-3237-05	PIN CONNECTOR	2P		
P014	E40-3238-05	PIN CONNECTOR	3P		
P015	E40-4248-05	PIN CONNECTOR	2P		
P016	E40-4248-05	PIN CONNECTOR	2P		
P017	E40-3237-05	PIN CONNECTOR	2P		
P018	E40-4248-05	PIN CONNECTOR	2P		
P019	E40-4248-05	PIN CONNECTOR	2P		
P020	E40-4248-05	PIN CONNECTOR	2P		
P021	E40-4248-05	PIN CONNECTOR	2P		
P032	E23-0582-05	TERMINAL			
P033	E23-0582-05	TERMINAL			
P034	NO USE				
P035	E23-0582-05	TERMINAL			
P036	NO USE				
P037	E23-0582-05	TERMINAL			
P038	NO USE				
P039	E23-0582-05	TERMINAL			
Q001	2SA1209(R,S)	TR. SI. PNP			
Q002	2SC2911(R,S)	TR. SI. NPN			
Q003	2SA1209(R,S)	TR. SI. PNP			
Q004	2SC2911(R,S)	TR. SI. NPN			
Q005	2SC1815(Y)	TR. SI. NPN			
Q006	2SC1815(Y)	TR. SI. NPN			
R004	RD14BB2C910J	RES. CARBON	91	5%	1/6W
R005	RD14BB2C241J	RES. CARBON	240	5%	1/6W
R006	RN14BK2C6201F	RES. METAL FILM	6.2K	1%	1/6W
R007	RN14BK2C1002F	RES. METAL FILM	10K	1%	1/6W
R008	RN14BK2C9530F	RES. METAL FILM	953	1%	1/6W
R009	RN14BK2C9530F	RES. METAL FILM	953	1%	1/6W
R010	RD14BB2C112J	RES. CARBON	1.1K	5%	1/6W
R011	RN14BK2C8200F	RES. METAL FILM	820	1%	1/6W
R012	RN14BK2C3001F	RES. METAL FILM	3K	1%	1/6W
R013	RN14BK2C1500F	RES. METAL FILM	150	1%	1/6W
R014	RD14BB2E152J	RES. CARBON	1.5K	5%	1/4W
R015	RN14BC2B3001CKW	RES. METAL FILM	3K	0.25%	1/8W
R016	RN14BC2B3001CKW	RES. METAL FILM	3K	0.25%	1/8W
R017	RN14BC2B3001CKW	RES. METAL FILM	3K	0.25%	1/8W
R018	RN14BC2B3001CKW	RES. METAL FILM	3K	0.25%	1/8W
R019	RN14BC2B1202CKW	RES. METAL FILM	12K	0.25%	1/8W
R020	RN14BC2B1202CKW	RES. METAL FILM	12K	0.25%	1/8W
R021	RN14BC2B1202CKW	RES. METAL FILM	12K	0.25%	1/8W
R022	RN14BC2B1202CKW	RES. METAL FILM	12K	0.25%	1/8W
R023	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R024	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R025	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R026	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R027	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R028	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R029	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R030	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R036	RD14BB2E152J	RES. CARBON	1.5K	5%	1/4W
R037	RD14BB2E152J	RES. CARBON	1.5K	5%	1/4W
R038	RD14BB2E152J	RES. CARBON	1.5K	5%	1/4W
R039	RD14BB2E152J	RES. CARBON	1.5K	5%	1/4W
R040	R92-1465-05	RES. COMPLEX	2K,10K		
R041	R92-1465-05	RES. COMPLEX	2K,10K		
R042	R92-1465-05	RES. COMPLEX	2K,10K		
R043	R92-1465-05	RES. COMPLEX	2K,10K		
R052	RD14BB2C162J	RES. CARBON	1.6K	5%	1/6W
R053	RD14BB2C162J	RES. CARBON	1.6K	5%	1/6W
R054	RD14BB2C162J	RES. CARBON	1.6K	5%	1/6W
R055	RD14BB2C162J	RES. CARBON	1.6K	5%	1/6W
R056	RD14BB2C512J	RES. CARBON	5.1K	5%	1/6W
R057	RD14BB2C153J	RES. CARBON	15K	5%	1/6W
R058	RD14BB2C512J	RES. CARBON	5.1K	5%	1/6W
R059	R92-1455-05	RES. CEMENT	0.47	5%	5W
R060	R92-1455-05	RES. CEMENT	0.47	5%	5W
R061	R92-1455-05	RES. CEMENT	0.47	5%	5W
R062	R92-1456-05	RES. CEMENT	1	5%	3W
R063	RD14BB2C161J	RES. CARBON	160	5%	1/6W
R064	RD14BB2C161J	RES. CARBON	160	5%	1/6W
R065	RD14BB2C181J	RES. CARBON	180	5%	1/6W
R066	RD14BB2C161J	RES. CARBON	160	5%	1/6W
R067	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R068	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R069	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R070	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R071	RD14BB2C511J	RES. CARBON	510	5%	1/6W
R072	RD14BB2C511J	RES. CARBON	510	5%	1/6W
R073	RD14BB2C511J	RES. CARBON	510	5%	1/6W
R074	RD14BB2C511J	RES. CARBON	510	5%	1/6W
R075	RN14BK2C1602F	RES. METAL FILM	16K	1%	1/6W
R076	RN14BK2C1801F	RES. METAL FILM	1.8K	1%	1/6W
R077	RN14BK2C1602F	RES. METAL FILM	16K	1%	1/6W
R078	RN14BK2C1801F	RES. METAL FILM	1.8K	1%	1/6W
R079	RN14BK2E2004F	RES. METAL FILM	2M	1%	1/4W
R080	RN14BK2E2004F	RES. METAL FILM	2M	1%	1/4W
R081	RN14BK2C1004F	RES. METAL FILM	1M	1%	1/6W
R082	RN14BK2C1004F	RES. METAL FILM	1M	1%	1/6W
R083	RD14BB2C331J	RES. CARBON	330	5%	1/6W
R084	RD14BB2C331J	RES. CARBON	330	5%	1/6W
R085	RD14BB2C331J	RES. CARBON	330	5%	1/6W
R086	RD14BB2C331J	RES. CARBON	330	5%	1/6W

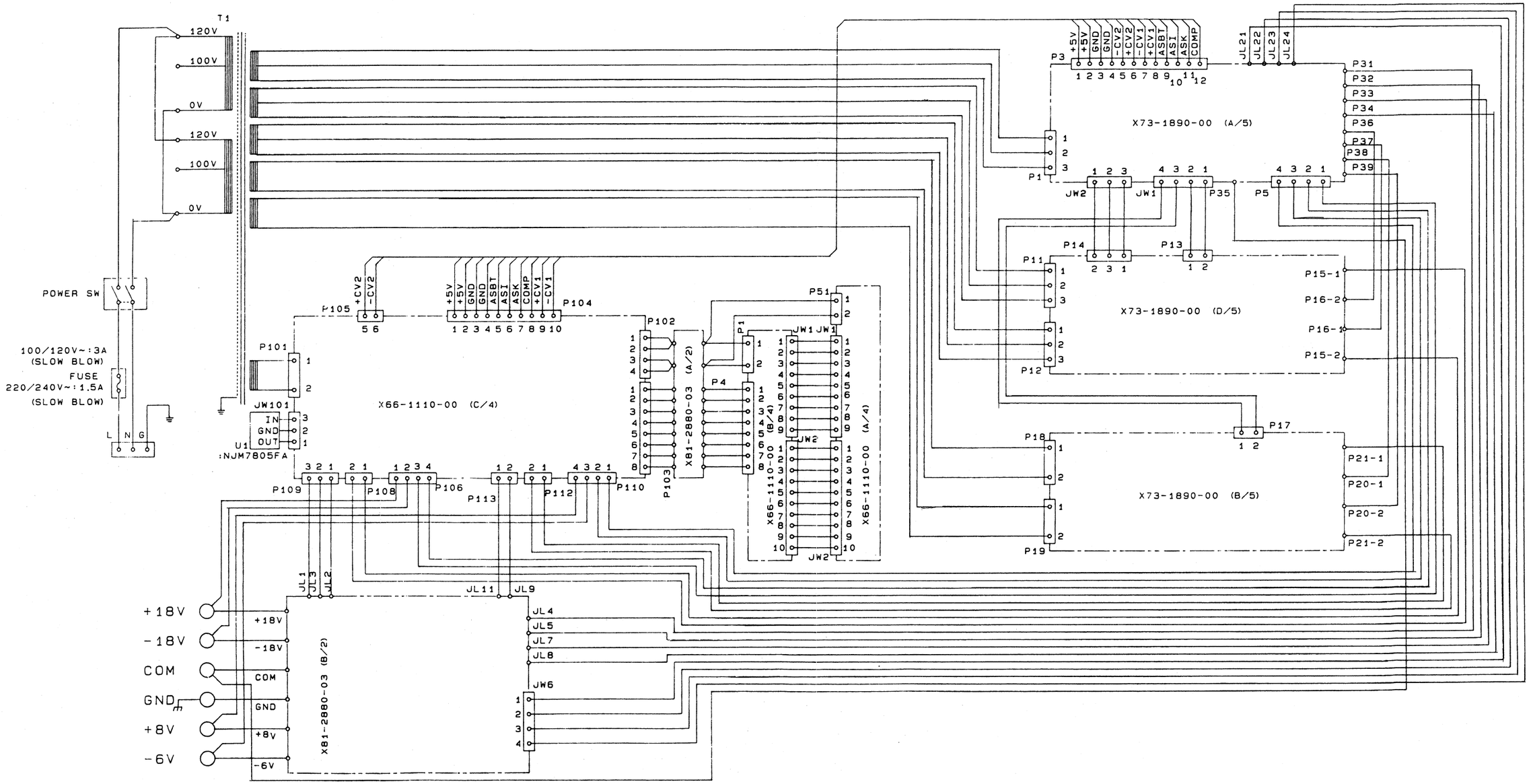
PARTS LIST

REF.NO	PARTS NO	NAME & DESCRIPTION			
R087	RD14BB2C361J	RES. CARBON	360	5%	1/6W
R088	RD14BB2C361J	RES. CARBON	360	5%	1/6W
R101	RD14DB3AR51J	RES. CARBON	0.51	5%	1W
R102	RD14DB3AR51J	RES. CARBON	0.51	5%	1W
R103	RD14DB3AR51J	RES. CARBON	0.51	5%	1W
R104	RD14DB3AR51J	RES. CARBON	0.51	5%	1W
R105	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R106	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R107	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R108	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R109	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R110	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R111	RD14DB3AR51J	RES. CARBON	0.51	5%	1W
R112	RD14DB3AR51J	RES. CARBON	0.51	5%	1W
R113	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R114	RD14BB2E101J	RES. CARBON	100	5%	1/4W
R115	RD14DB3A561J	RES. CARBON	560	5%	1W
R116	RD14DB3A561J	RES. CARBON	560	5%	1W
R117	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R118	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R119	RD14BB2E561J	RES. CARBON	560	5%	1/4W
R120	RD14BB2C122J	RES. CARBON	1.2K	5%	1/6W
R127	R92-1061-05	JUMPING RES.	ZERO OHM (5MM)		
R128	R92-1061-05	JUMPING RES.	ZERO OHM (5MM)		
R129	RN14BK2C1101F	RES. METAL FILM	1.1K	1%	1/6W
R130	RN14BK2C1101F	RES. METAL FILM	1.1K	1%	1/6W
R131	RN14BK2C2200F	RES. METAL FILM	220	1%	1/6W
R132	RN14BK2C2200F	RES. METAL FILM	220	1%	1/6W
R133	RD14BB2C162J	RES. CARBON	1.6K	5%	1/6W
R134	RD14BB2C162J	RES. CARBON	1.6K	5%	1/6W
R135	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R136	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R137	RD14BB2C104J	RES. CARBON	100K	5%	1/6W
R138	RD14BB2C104J	RES. CARBON	100K	5%	1/6W
R139	RD14DB3AR51J	RES. CARBON	0.51	5%	1W
U001	NJM7812FA	IC,3-TERMINAL REGULATOR			
U002	NJM7912FA	IC,3-TERMINAL REGULATOR			
U003	NJM7805FA	IC,3-TERMINAL REGULATOR			
U004	NJM4558D	IC,DUAL OP AMP			
U005	NJM072BD	IC,JFET INPUT OP AMP			
U006	NJM072BD	IC,JFET INPUT OP AMP			
U007	NJM072BD	IC,JFET INPUT OP AMP			
U008	NJM072BD	IC,JFET INPUT OP AMP			
U009	NJM4558D	IC,DUAL OP AMP			
U010	NJM4558D	IC,DUAL OP AMP			
U011	NJM4558D	IC,DUAL OP AMP			
U012	NJM4558D	IC,DUAL OP AMP			
U013	TC4094BP	IC,8-STAGE SHIFT/STORE REGISTE			
U014	TC4094BP	IC,8-STAGE SHIFT/STORE REGISTE			
U015	TC4094BP	IC,8-STAGE SHIFT/STORE REGISTE			
U016	NJM4560D	IC,OP AMP			
U017	AM6012DC	IC,12-BIT D/A CONVERTER			
U018	HD14052BP	IC,DUAL ANALOG MULTIPLEXER			
U019	HD14051BP	IC,ANALOG MULTIPLEXER			
U020	HD14052BP	IC,DUAL ANALOG MULTIPLEXER			
U021	PC619	IC,PHOTO COUPLER			
U022	PC619	IC,PHOTO COUPLER			
U025	TC74HC138AP	IC,3 TO 8 DEMULTIPLEXER			
U026	NJM4558D	IC,DUAL OP AMP			
VR001	R12-0556-05	RES. SEMI FIXED 100 B			
VR002	R12-0556-05	RES. SEMI FIXED 100 B			
VR003	R12-0541-05	RES. SEMI FIXED 100 B			
VR004	R12-0541-05	RES. SEMI FIXED 100 B			
VR005	R12-0541-05	RES. SEMI FIXED 100 B			
VR006	R12-0541-05	RES. SEMI FIXED 100 B			

TERMINAL UNIT
(X81-2880-03)

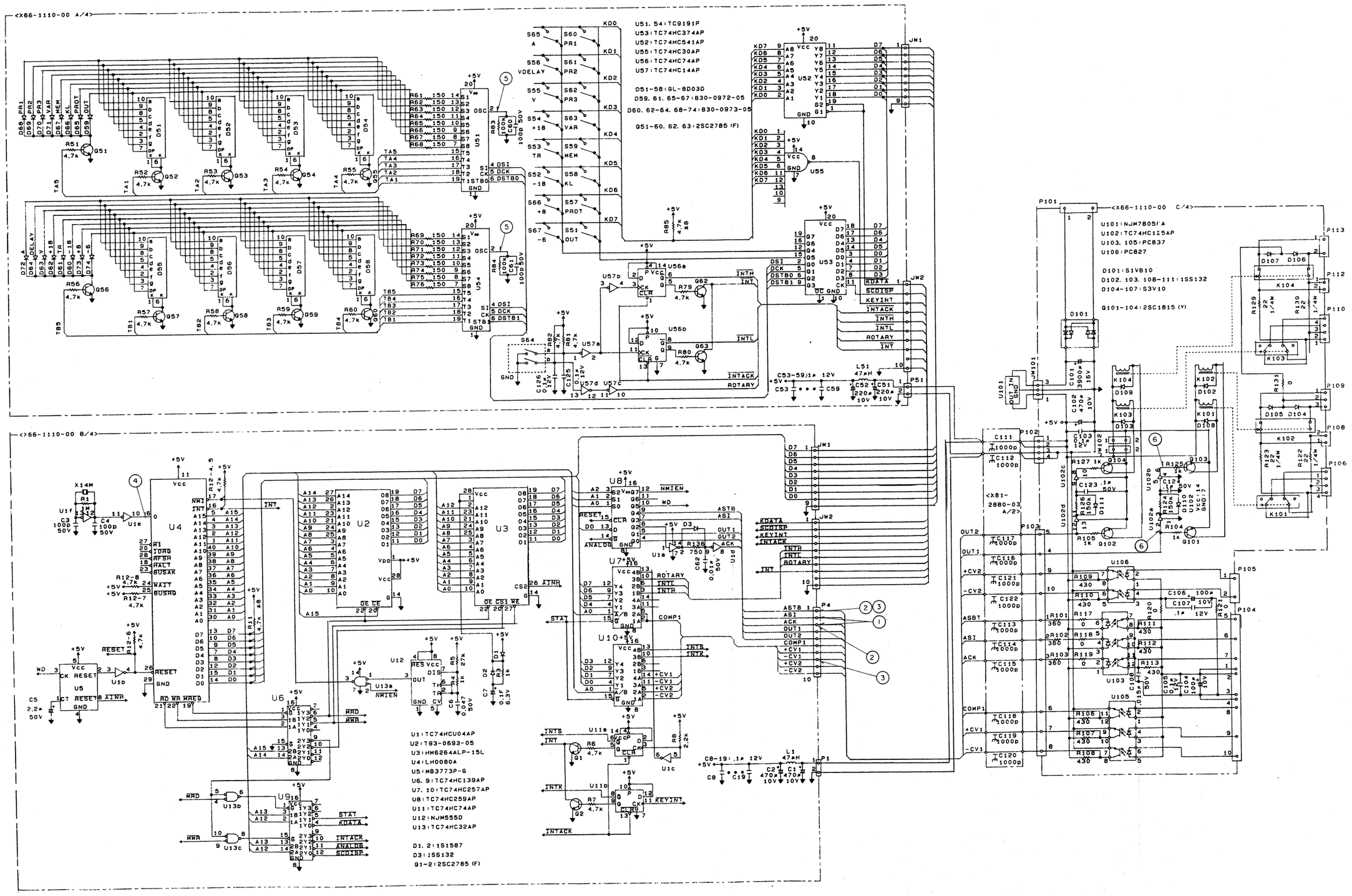
REF.NO	PARTS NO	NAME & DESCRIPTION			
	E38-0022-05	WIRE ASS'Y:P109 TO JL1,2,3			
	E38-0023-05	WIRE ASS'Y:P110 TO JL9,11			
	E38-0105-05	WIRE ASS'Y:P31-34 TO JW 4,5,7,			
	J73-0019-03	PCB (UNMOUNTED)			
C001	CE04EW1E471M	CAP. ELECTRO	470	20%	25V
C002	CE04EW1E471M	CAP. ELECTRO	470	20%	25V
C003	CE04EW1C471M	CAP. ELECTRO	470	20%	16V
C004	CE04EW1A221M	CAP. ELECTRO	220	20%	10V
C111	C91-0579-05	CAP. CERAMIC	1000P		500V
C112	C91-0579-05	CAP. CERAMIC	1000P		500V
C113	C91-0579-05	CAP. CERAMIC	1000P		500V
C114	C91-0579-05	CAP. CERAMIC	1000P		500V
C115	C91-0579-05	CAP. CERAMIC	1000P		500V
C116	C91-0579-05	CAP. CERAMIC	1000P		500V
C117	C91-0579-05	CAP. CERAMIC	1000P		500V
C118	C91-0579-05	CAP. CERAMIC	1000P		500V
C119	C91-0579-05	CAP. CERAMIC	1000P		500V
C120	C91-0579-05	CAP. CERAMIC	1000P		500V
C121	C91-0579-05	CAP. CERAMIC	1000P		500V
C122	C91-0579-05	CAP. CERAMIC	1000P		500V
R001	RD14DB3D301J	RES. CARBON	300	5%	2W
R002	RD14DB3D301J	RES. CARBON	300	5%	2W
R003	RD14BB2E561J	RES. CARBON	560	5%	1/4W
R004	R92-0150-05	JUMPING RES.	ZERO OHM(10MM)		
R005	NO USE				
R006	RD14BB2C122J	RES. CARBON	1.2K	5%	1/6W
R007	R92-1061-05	JUMPING RES.	ZERO OHM (5MM)		

SCHEMATIC DIAGRAM

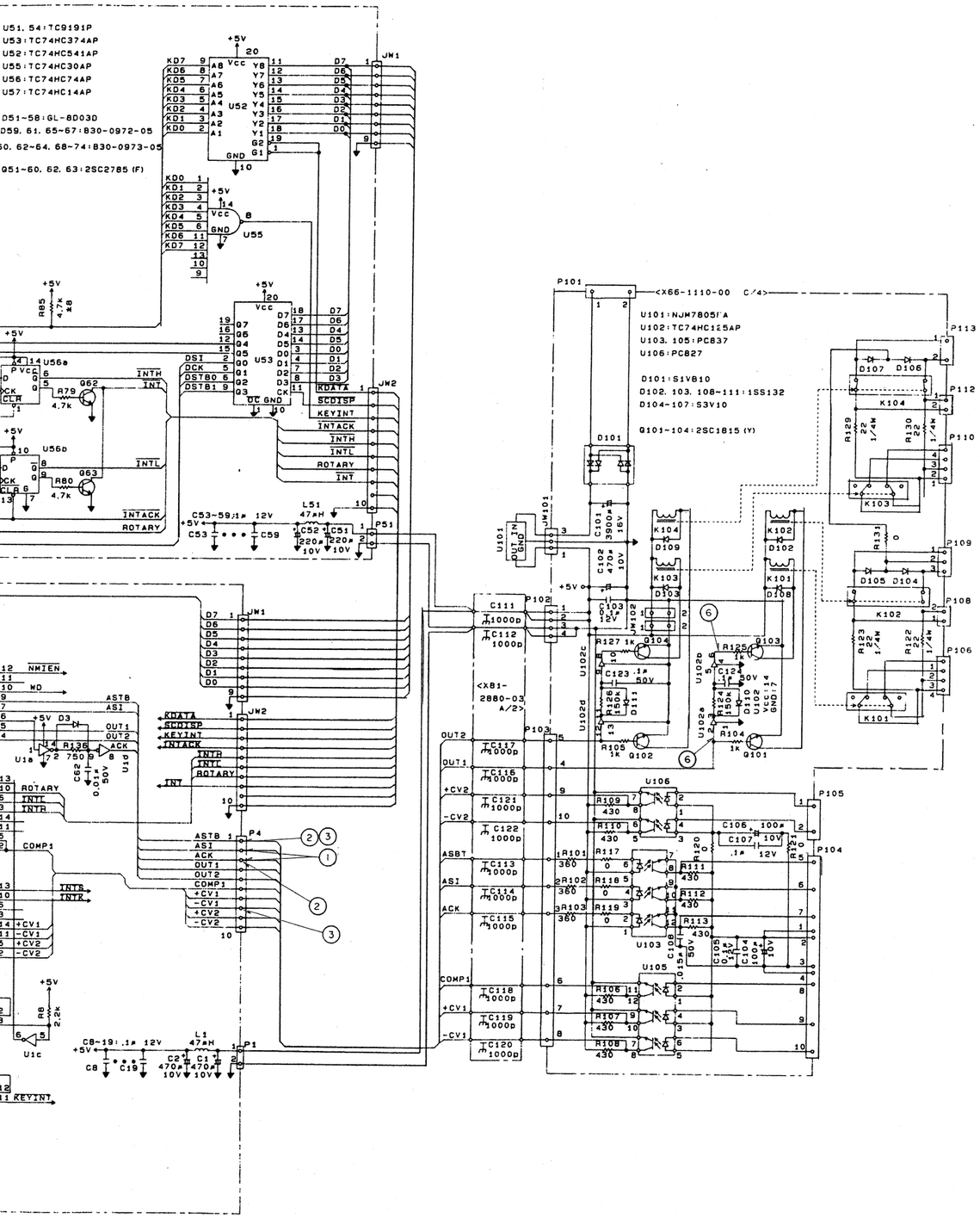


SCHEMATIC DIAGRAM

PW18-1.8Q SCHEMATIC DIAGRAM

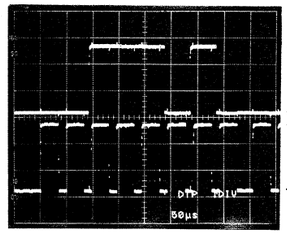


MATIC DIAGRAM



WAVEFORM

①

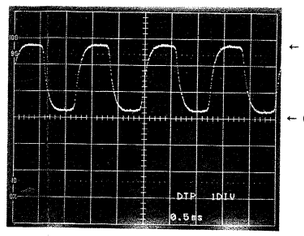


P4-2 Waveform
In case of X73-1890-00, it takes DATA Waveform.

P4-3 Waveform
In case of X73-1890-00, it takes STROBE Waveform.

50µs/diV

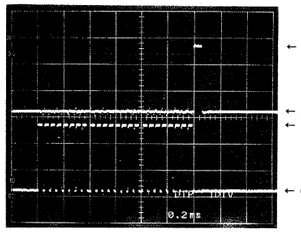
④



U4-6 Waveform, CPU Clock Waveform

0.5ms/diV

②

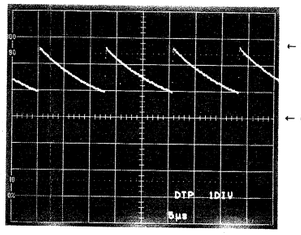


P4-1 Waveform
In case of X73-1890-00, it takes CLOCK Waveform.

P4-3 Waveform

0.2ms/diV

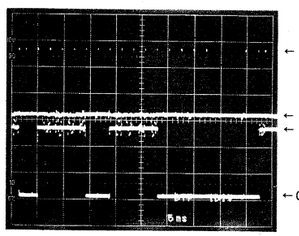
⑤



U51 and 52-2 Waveform

5µs/diV

③

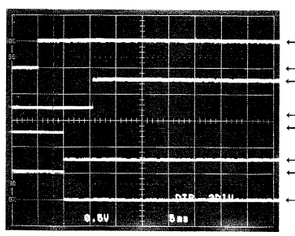


P4-1 Waveform

P4-6 Waveform
In case of X73-1890-00, it takes P20-10 Waveform.

5ms/diV

⑥

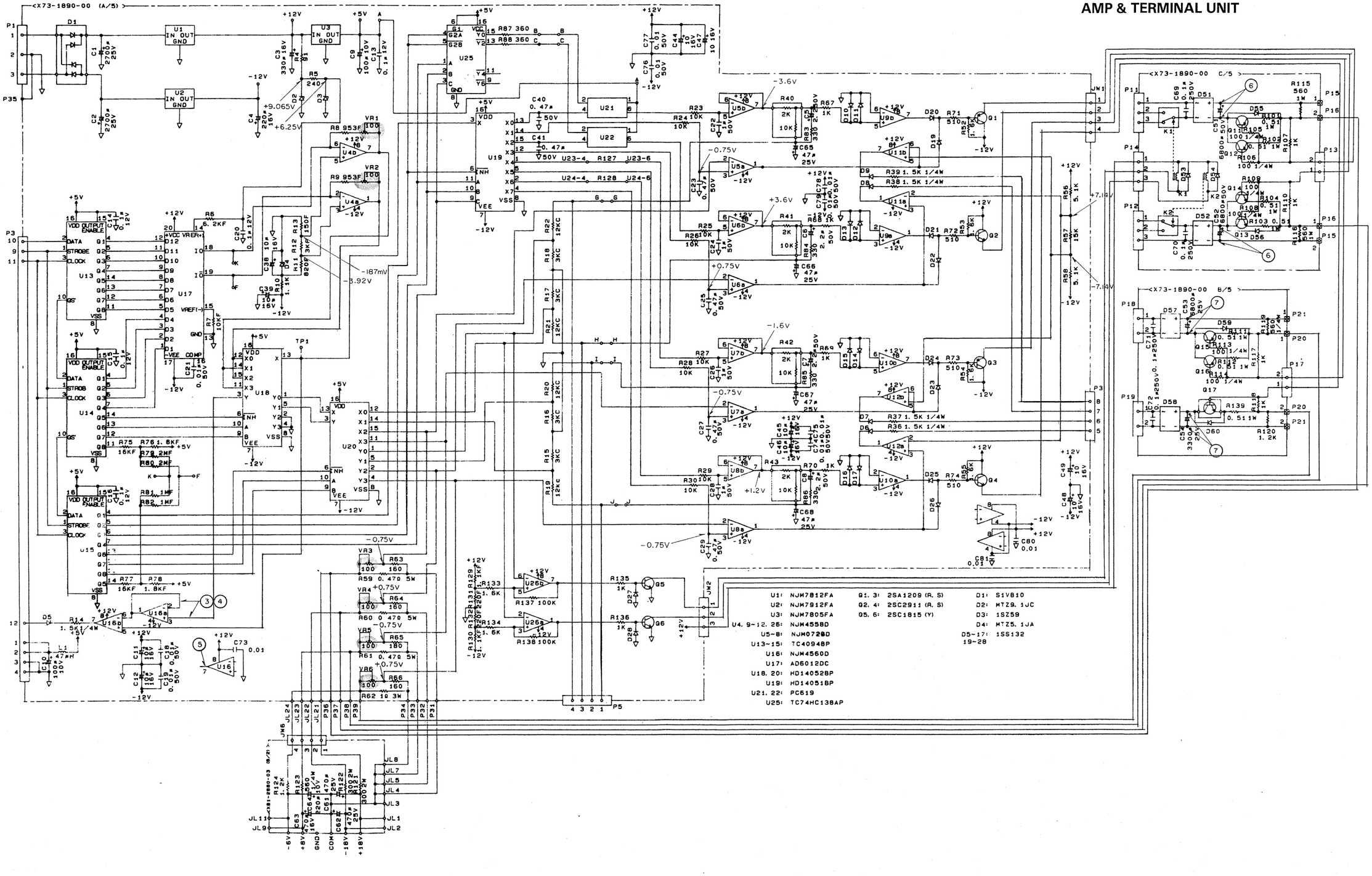


U102-2 Waveform (for K101 disturbance)
U102-6 Waveform (for K102 disturbance)
During OUTPUT is ON
U102-7 Waveform (for K101 disturbance)
U102-6 Waveform (for K102 disturbance)
During OUTPUT is OFF

3V/diV, 5ms/diV

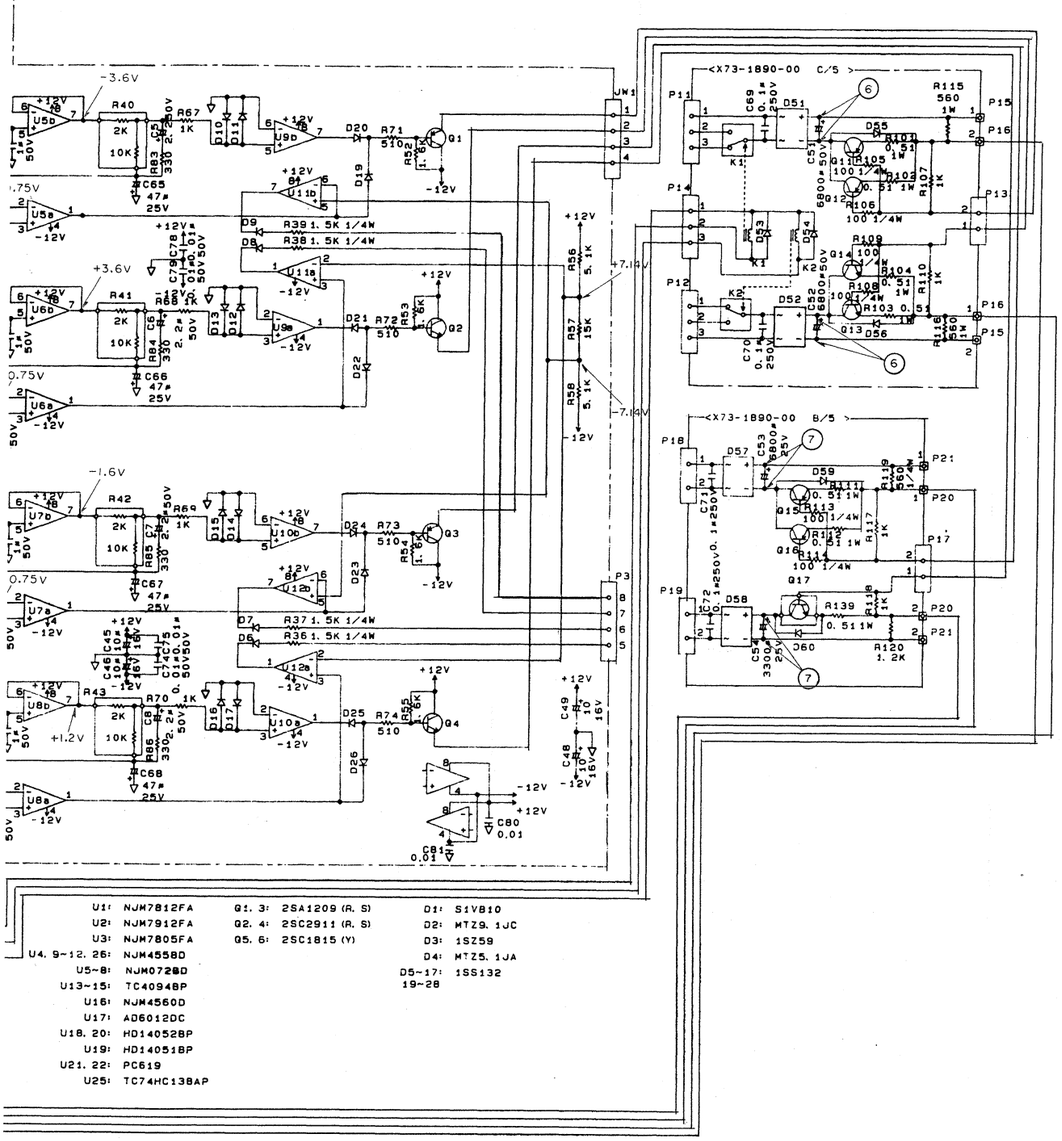
SCHEMATIC DIAGRAM

AMP & TERMINAL UNIT



GRAM

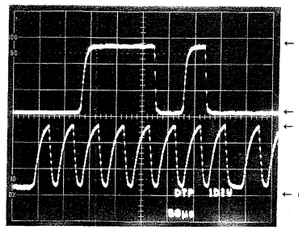
AMP & TERMINAL UNIT



U1:	NJM7812FA	Q1, 3: 2SA1209 (R, S)	D1: S1VB10
U2:	NJM7912FA	Q2, 4: 2SC2911 (R, S)	D2: MTZ9.1JC
U3:	NJM7805FA	Q5, 6: 2SC1815 (Y)	D3: 1SZ59
U4, 9~12, 26:	NJM4558D		D4: MTZ5.1JA
U5~8:	NJM072BD		D5~17, 19~28: 1SS132
U13~15:	TC4094BP		
U16:	NJM4560D		
U17:	AD6012DC		
U18, 20:	HD14052BP		
U19:	HD14051BP		
U21, 22:	PC619		
U25:	TC74HC138AP		

WAVEFORM

①

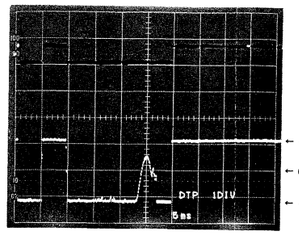


50μs/diV

P3-10 Waveform
Since it is DATA waveform, it does not always take this waveform.

P3-9 Waveform
STROBE Waveform
It sends data sent in serial forms into U3, and performs data shift.

⑤



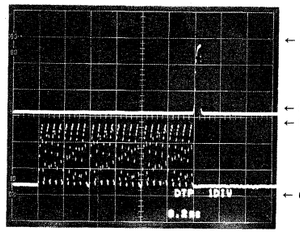
5ms/diV

Since this waveform is compared by a comparer on a serial manner, it does not always take this waveform.

U16-7 Wareform

Capacitor for +18 and −18 outputs
Input: AC 100 V
Output: ±1.8 A

②

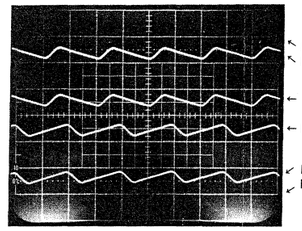


0.2ms/diV

P3-11 Waveform
CLOCK Waveform
It outputs data sent in serial forms from U3 and 4 as parallel data.

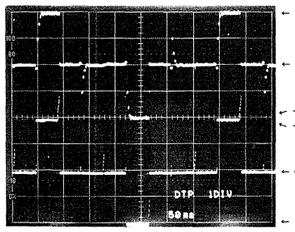
P3-9 Waveform
STROBE Waveform
Since volume of data is 24 (3×8), one set of this waveform consist of 24 pulses.

⑥


↖ Positive terminal for C52
↖ Positive terminal for C51 (when K1 is a high tap)
← Positive terminal for C51 (when K1 is a low tap)
← Negative terminal for C52 (when K2 is a low tap)
↙ Negative terminal for C52 (when K2 is a high tap)
↙ Negative terminal for C51

5V/diV, 5ms/diV

③



50ms/diV

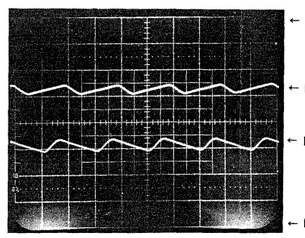
U16-3 Waveform

OUTPUT is ON.
Output voltage: Rating
Output current: OA

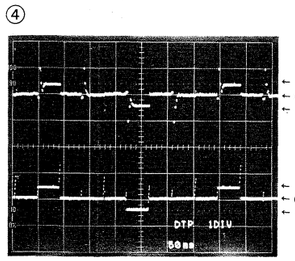
U16-2 Waveform

⑦

Capacitor for +8 and −6 outputs
Input: AC 100 V


← Positive terminal for C54
← Negative terminal for C54
Output: 1 A
← Positive terminal for C53
← Negative terminal for C53
Output: 2 A

④



50ms/diV

U16-3 Waveform

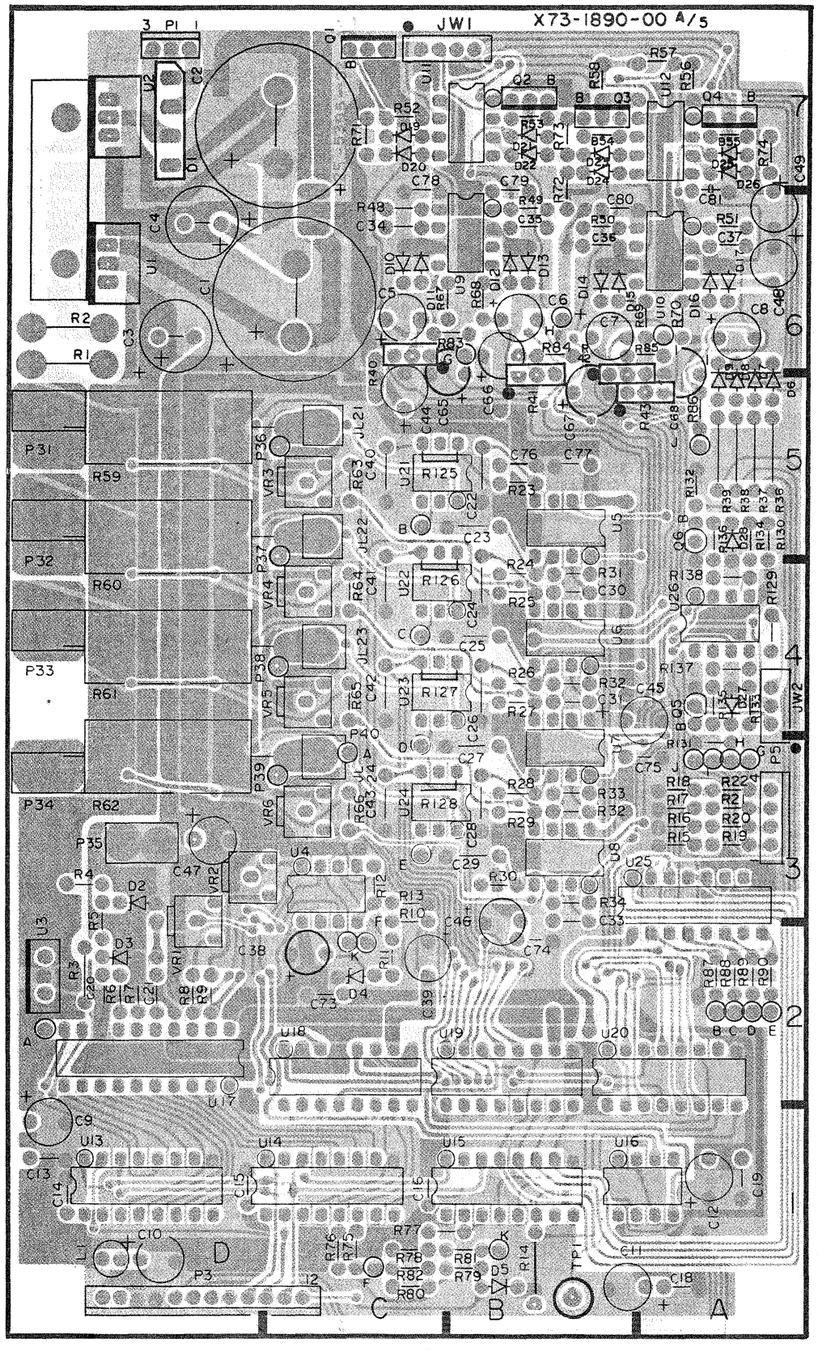
OUTPUT is ON.
Output terminal: Short-circuit
Output current: Rating

U16-2 waveform

P.C. BOARD

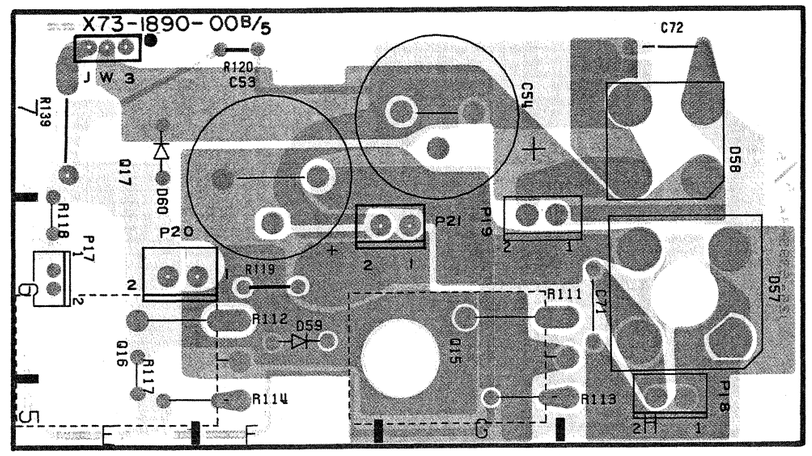
AMP UNIT (A/5)

Pattern side view



AMP UNIT (B/5)

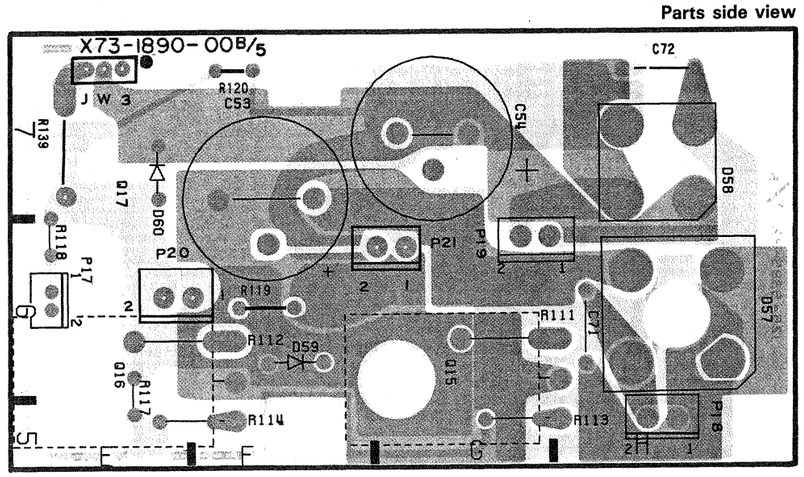
Parts side view



P.C. BOARD

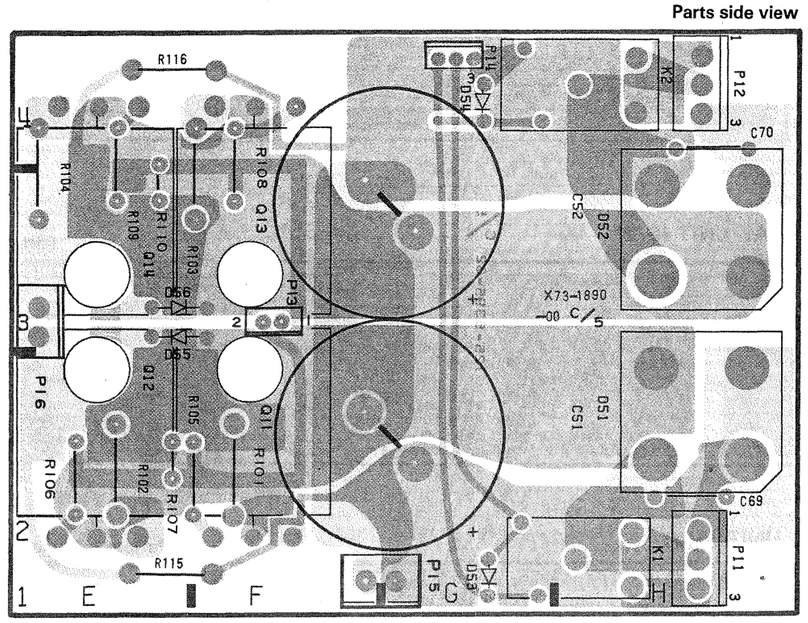
AMP UNIT (B/5)

Parts side view



AMP UNIT (C/5)

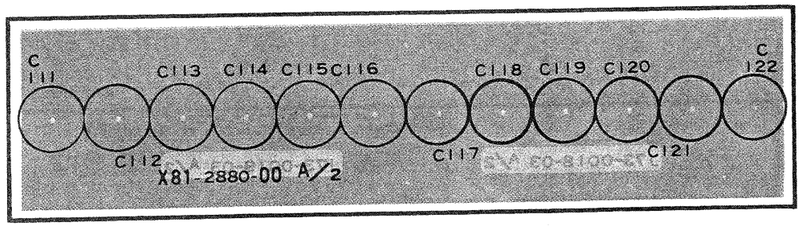
Parts side view



P.C. BOARD

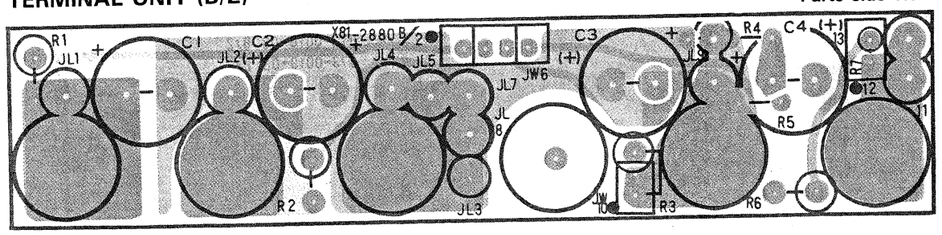
TERMINAL UNIT (A/2)

Parts side view



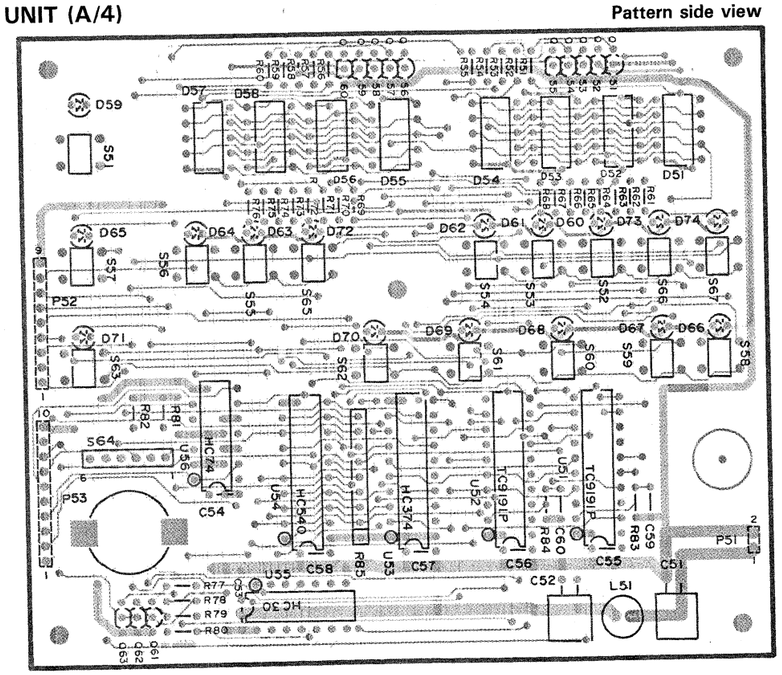
TERMINAL UNIT (B/2)

Parts side view



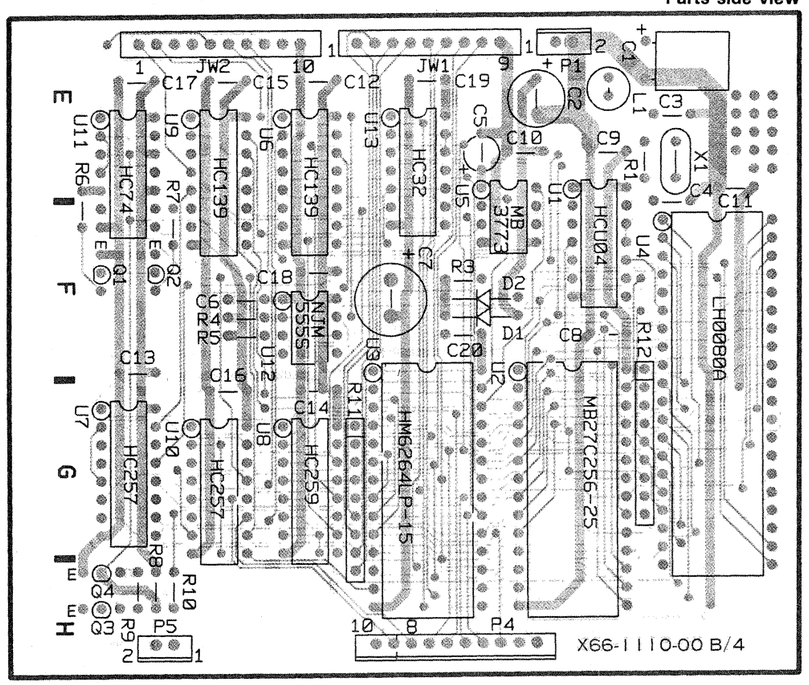
PANEL UNIT (A/4)

Pattern side view



PANEL UNIT (B/4)

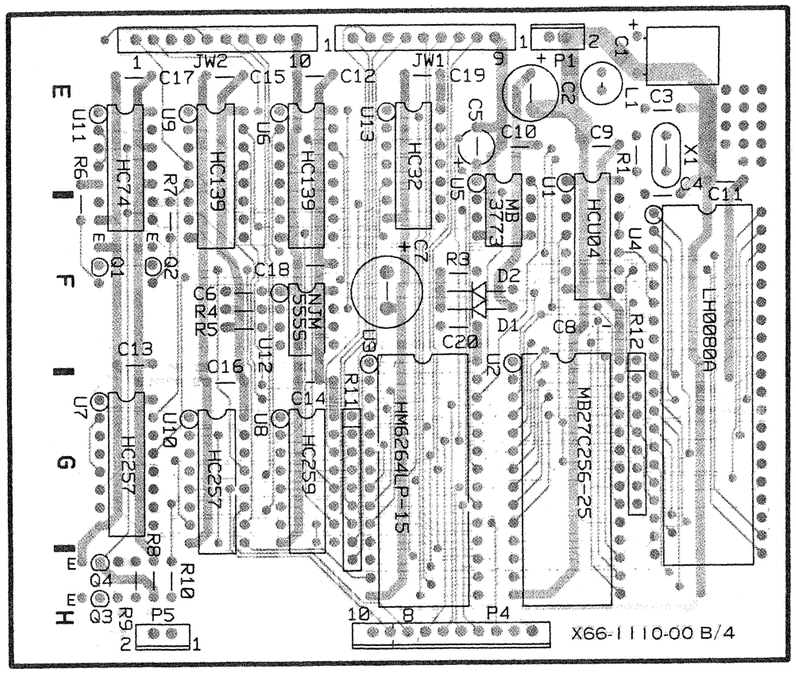
Parts side view



P.C. BOARD

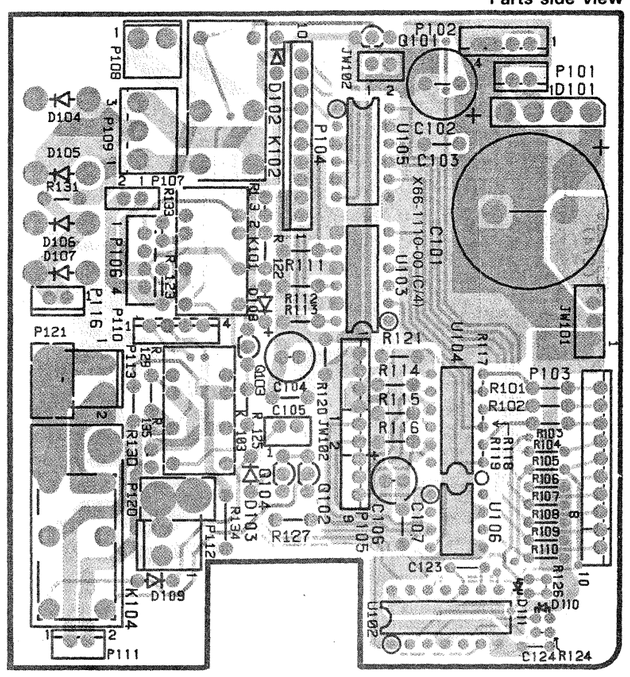
PANEL UNIT (B/4)

Parts side view

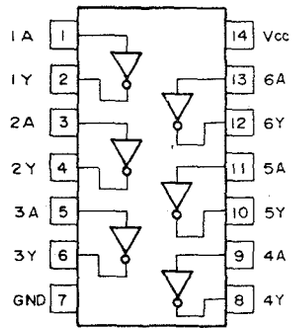


PANEL UNIT (C/4)

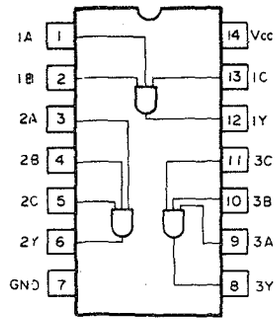
Parts side view



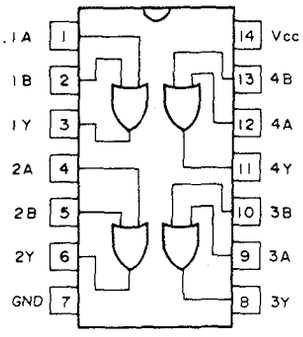
SEMICONDUCTORS



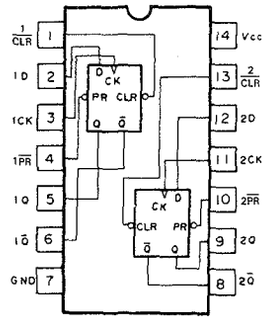
TC74HCU04AP



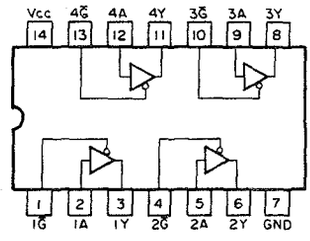
TC74HC11AP



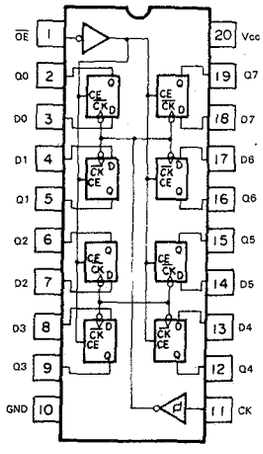
TC74HC32AP



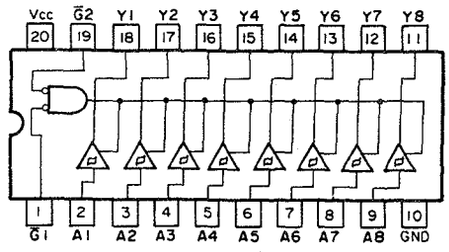
TC74HC74AP



TC74HC125AP

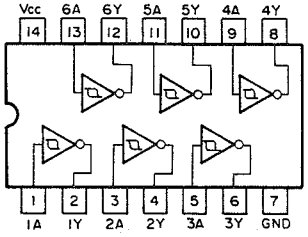


TC74HC374AP

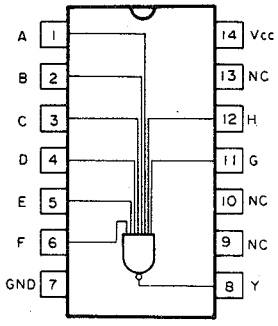


TC74HC541AP

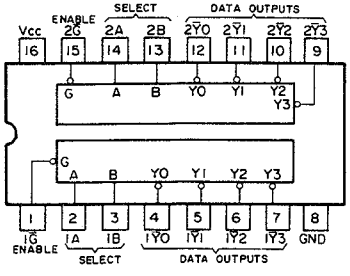
SEMICONDUCTORS



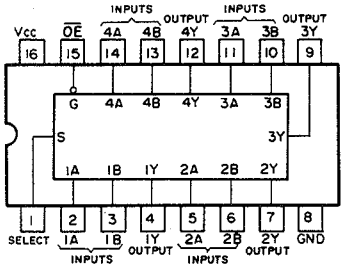
TC74HC14AP



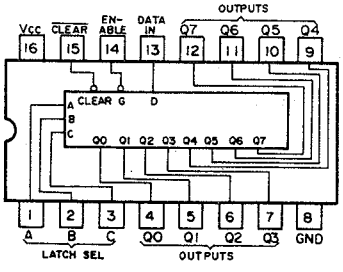
TC74HC30AP


SELECT
ENABLE
DATA OUTPUTS
Vcc 2G 2A 2B 2Ȳ0 2Ȳ1 2Ȳ2 2Ȳ3
16 15 14 13 12 11 10 9
G A B Y0 Y1 Y2 Y3
1 2 3 4 5 6 7 8
1G 1A 1B 1Ȳ0 1Ȳ1 1Ȳ2 1Ȳ3 GND
ENABLE
SELECT
DATA OUTPUTS

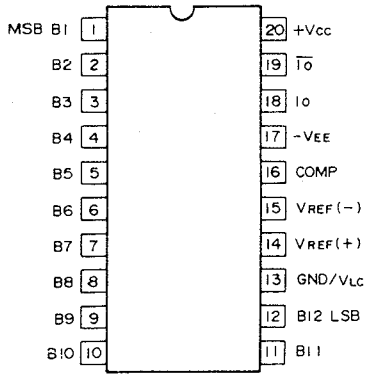
TC74HC139AP



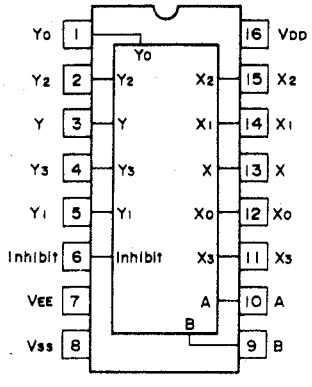
TC74HC257AP


OUTPUTS
Vcc CLEAR EN-ABLE DATA IN Q7 Q6 Q5 Q4
16 15 14 13 12 11 10 9
A CLEAR G D
B
C
Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7
1 2 3 4 5 6 7 8
A B C Q0 Q1 Q2 Q3 GND
LATCH SEL
OUTPUTS

TC74HC259AP

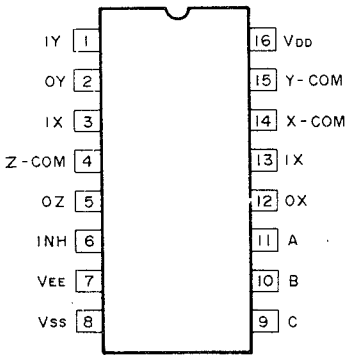


AM6012DC

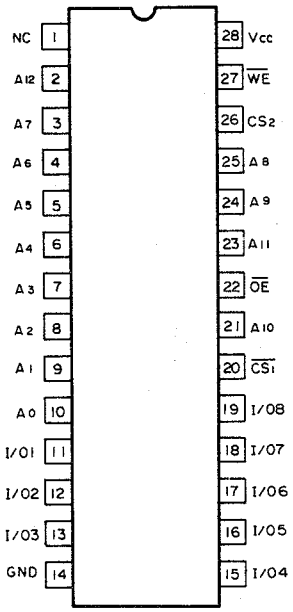


HD14052BP

SEMICONDUCTORS



HD14053BP



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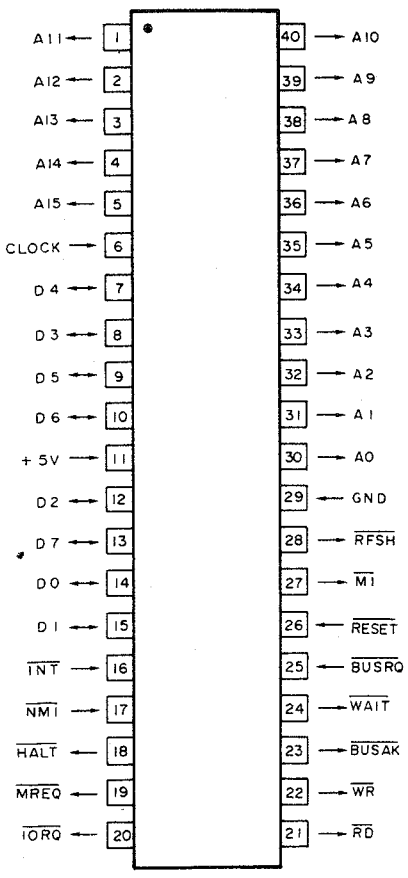

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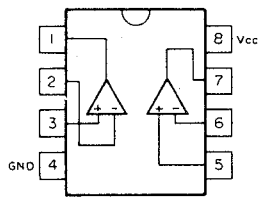

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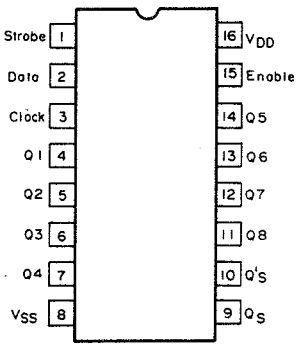
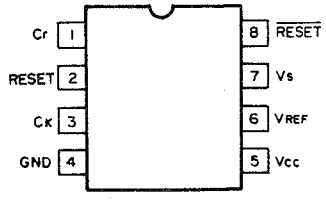


TC4094BP

SEMICONDUCTORS



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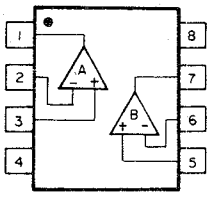
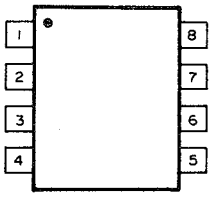


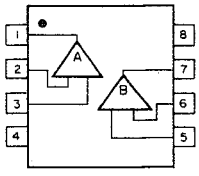
Pin name
1. A OUTPUT
2. A (−) INPUT
3. A (+) INPUT
4. V⁻
5. B (+) INPUT
6. B (−) INPUT
7. B OUTPUT
8. V⁺

NJM072BD



Pin name
1. GND
2. TRIGGER
3. OUTPUT
4. RESET
5. CONTROL VOLTAGE
6. SLESHHOLD
7. DISCHARGE
8. V⁺

NJM555D



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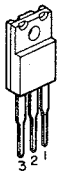
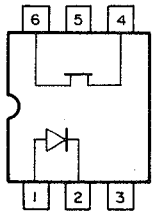
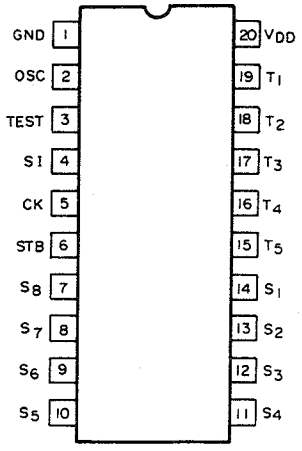


1. OUT
2. GND
3. IN

NJM7805FA



PC619



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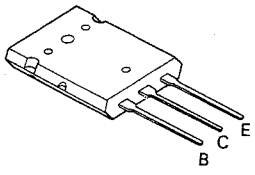

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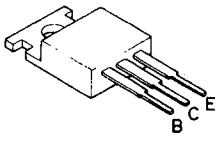
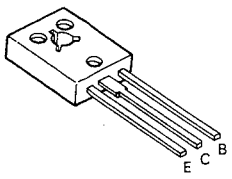
1302 (R)
2SC3280 (R)
3281 (R)



2SA1111 (Q)
2SC2591 (Q)

SEMICONDUCTORS



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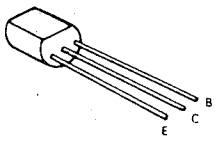

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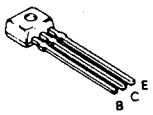

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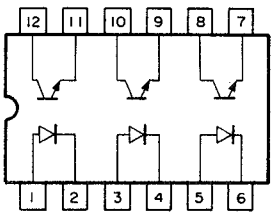
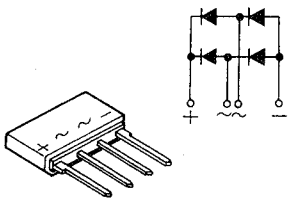
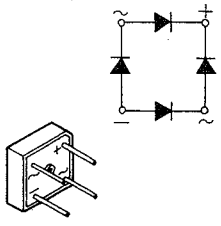


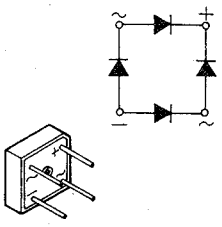
PC837



S1VB10



S4VB20F1



S10VB10
S10VB10F1